## No. 13352

# United States Court of Appeals

## for the Ninth Circuit

JULES D. GRATIOT and AIR-MAZE CORPORATION,

Appellants,

vs.

FARR COMPANY, a corporation,

Appellee.

# Transcript of Record

In Three Volumes

VOLUME II.
(Pages 425 to 837, inclusive)

Appeal from the United States District Court
for the Southern District of California,
Central Division



Phillips & Van Orden Co., 870 Brannan Street, San Francisco, Calif.

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(Testimony of Kenneth F. Russell.)

Direct Examination—(Continued)

The Court: Will it remove dust particles, was that your question?

Mr. Harris: Yes, any dust particles.

The Court: How does it operate? I cannot tell.

The Witness: The patent is not too complete so far as the entire unit is concerned. They merely describe one segment of a disc that rotates about an axis and this disc is rotating in a bay or tank as described on page 2, line 4.

The Court: Series of discs, and which is the disc? What is the difference between Fig. 2 and Fig. 1?

The Witness: Fig. 1 is a side view of Fig. 2. That is looking at it from the side. Consider Fig. 2 as if you should look at it from the right-hand side and you would see what is shown in Fig. 1.

By Mr. Harris:

Q. What relation does Fig. 2 have to these discs that you are talking about?

A. The discs of the entire unit is not shown in the drawings. Fig. 2 is merely a segment or a bundle of segments which, when bolted to a framework about an axis, forms a disc-like unit. [517]

Q. Like pieces of pie cut in segments?

A. Yes, Fig. 2 would be similar to a piece of pie to the filtering unit.

Q. So if you had the whole disc you would have a number of pieces of segment that were like this around the similar area? A. Yes.

(Testimony of Kenneth F. Russell.)

The Court: How would this rotate as to Fig. 1?

The Witness: If you continued the line on the left-hand side of Fig. 2——

The Court: So that the flow of water would be through these panels or against the plates here, which I think are called c-c?

The Witness: The unit, as I interpret it, would be one that would rotate into a tank.

The Court: So that these fins——

The Witness: Would be dipped with them as they rotate about.

The Court: The edges of the fins?

The Witness: Yes, or as much of the unit as would be necessary. [518]

If you take Fig. 2 and continue the line on the left and the line on the right and continue them down toward the bottom of the page, they would meet and they would be approximately the center of the shaft. Then, as you add more of these units around the circle, you would complete the entire unit.

The Court: What is Fig. 4? Can that be explained as a right-hand view of Fig. 5?

The Witness: Yes, Figs. 4, 5, and 6 are similar views to Figs. 1, 2, and 3, showing on page 2, line 22——

The Court: 4, 5, and 6?

The Witness: Figs. 4, 5, and 6 are views similar to Figs. 1, 2, and 3, respectively, showing an arrangement wherein a series of corrugated strips are placed between a series of boards or flat plates in

(Testimony of Kenneth F. Russell.)

the device shown in Figs. 1, 2, and 3, that place corrugated pieces together.

In the device shown in Figs. 4, 5, and 6 these corrugated plates are separated by separate plates, sheets of board, or material.

The Court: And in Fig. 1——

The Witness: Fig. 1?

The Court: ——and Fig. 3, the plate strips "a"?

The Witness: In Fig. 1, the figures "b" represent a corrugated strip; that is a side view of it.

The Court: What is "a"? [519]

The Witness: "a" is a corrugated strip with an end view.

Looking on Fig. 2, you will see "b" about the center of the drawing, indicating the corrugations as they are shown here vertically, and upon the same drawing, looking right below that, you will see "a", which indicates the corrugated plates with corrugations horizontally.

By Mr. Harris:

Q. Now, is there any teaching that the plates may be disposed with the corrugations at any different angle than that shown?

A. Yes. On page 2, lines 38 to 42.

Q. Will you read that to the Court?

A. "As shown in the drawings the corrugations of the sheets a, a and b, b are substantially at right angles to each other; it is to be understood, however, that the corrugations may be arranged at any other angle, it being only necessary that they should

(Testimony of Kenneth F. Russell.)
cross to a sufficient extent to prevent the plates from fitting closely one against the other."

Mr. Harris: Does Your Honor have any further question on this?

The Court: Not now.

By Mr. Harris:

Q. Next, Mr. Russell, will you turn to tab 13, which is the Row (British) Patent No. 13,222, dated June 11, 1904, and briefly describe to the Court the construction illustrated [520] in that patent?

A. This patent describes an improvement in air filters. The filtering unit is shown in Fig. 1, which is an end view which shows, for instance, the entrance view of the filter.

In Fig. 3 is shown a sectional view down through the middle of Fig. 1.

The unit consists of a series of parallel sheets, and the sheets are in the general direction of the air flow. These form passages through the filter, as illustrated in Fig. 2.

Q. The passages being what?

A. Which is a section taken on a line x-x on Fig. 1.

Pardon me; I did not hear that.

Q. Now, in Fig. 2, what are the sheets that you refer to, what number are they given, or letter?

A. The sheets in Fig. 2 are indicated as "a".

Q. And what are these passages that you refer to?

A. And the passages between the sheets are indicated as "b".

(Testimony of Kenneth F. Russell.)

Q. All right. What does this patent say that those sheets may be made of ?

A. On page 2, lines 43 to 49, it states that the sheets may be in the "form of reticulated metal work, but preferably sheets of perforated metal, or sheets of woven wire, or strips or lengths of what is known as 'expanded' metal * * *" [521]

Q. Is there any illustration of such a sheet of woven wire in this patent?

A. Yes. The various metals are shown in views, Fig. 5, Fig. 7, and Fig. 9.

Q. What does Fig. 8 show?

A. Fig. 8 shows an end view of the material in Fig. 7, which shows a unit of woven wire.

Q. Is that corrugated?

A. And the woven wire is corrugated.

Q. How are those corrugations disposed, turning back to Fig. 2?

A. The corrugations are arranged in such an order that they mesh into one another, to form passages that are not straight through.

Q. Where do those passages extend or how do they extend?

A. The passages extend in the general direction of the air flow. The air entering the unit is indicated as the arrows at the lower portion of Fig. 2, and the air flowing out is indicated by arrows at the upper side of Fig. 2.

Q. All right. What is the construction illustrated in Fig. 14?

(Testimony of Kenneth F. Russell.)

A. Fig. 14 shows the same type of plates with the bend near their mid-point, and these sheets are also arranged in parallel and spaced in accordance with the drawing [522] relatively close together.

The Court: Now, you said Fig. 1 is the face of the filter, is it?

The Witness: Yes, Fig. 1.

The Court: In other words, air flows in through the surface, that is, the face of it?

The Witness: That is right. That is the front, exterior view.

The Court: The front. Now, you said in Fig. 2 the openings between the plates are indicated by the letter "b"?

The Witness: Yes, Your Honor.

The Court: In Fig. 1, the letter "b" seems to indicate, tiny holes only on cross-bars, two cross-bars which are disposed, one toward the top and one toward the bottom.

Mr. Harris: Your Honor is right.

The Witness: Your Honor is right.

The Court: What is that?

The Witness: Your Honor is right. I am in error. These units, these parallel plates, are spaced apart, and in order to maintain their spaced relationship, with each other, they have a wavy partition, thus indicated by the letter "b", and in view 1 those are the little dashes that go across up there near the top and also near the bottom of the drawing.

(Testimony of Kenneth F. Russell.)

And in Fig. 2 shows a plan view of those spaces and indicates them as "b", and I mistook those. [523]

The Court: Where does the air get into this apparatus, on Fig. 1, through those little things, dots and dashes on crossbars "b"?

The Witness: No, Your Honor.

The Court: Or along those straight lines running vertical of the drawing, is that where the air flows in?

The Witness: The air flows in between—through the hole between the parallel lines, the vertical parallel lines.

By Mr. Harris:

Q. On Fig. 1, you mean? A. In Fig. 1.

The Court: Then, the plate, that is the material across which the air flows, is illustrated by Fig. 3, is that right? Fig. 3?

The Witness: Yes, that is one. That is a side view of the unit, yes, Your Honor.

The Court: All right. They are straight, they are not corrugated, and the only things that are corrugated are these crossbars "b", one at the top and one at the bottom, to hold the plates apart, is that right?

The Witness: But the plates are also corrugated to the same form.

The Court: Where is the cross-section to the plates?

The Witness: Fig. 2 shows a view which gives both the plan view of the spaces between the plates and the edges of [524] the plates. The lines represent the edge of the plate looking down at it.

(Testimony of Kenneth F. Russell.)

The Court: As if you were looking at it from the top?

The Witness: From the top, if you took it through the lines x-x.

The Court: b, b, those are the spacers?

The Witness: "b" actually indicates the spacer, yes.

The Court: Is that also the plate? Where does it say that in the patent?

The Witness: On page 3, lines 1 to 5, it describes the construction, where it states, "Each sheet or strip is corrugated, fluted or indented longitudinally,"——

Q. (By Mr. Harris): Will you read the rest of that?

A. ——or formed to a ridge or V-section, or each sheet is left plain and placed diagonally to the plane of the front edge of the filter, or in such other manner that when assembled the several sheets serve to baffle or deflect the incoming air as well as divide it up into a number of streams."

Q. Now, I hand you a couple of sheets of scrap paper and ask you, if you can, by the use of those two sheets of blank paper, illustrate to the Court how these sheets or plates in the Row patent are generally placed relative to each other.

A. The plates are generally placed parallel to each other. However, the sheets are corrugated, the sheets are corrugated along the edge. [525]

Q. Can you hold the two sheets up and show the Court how they are placed or spaced?

(Testimony of Kenneth F. Russell.)

A. The sheets are spaced by a spacer "b" as indicated by a letter "b" in Fig. 1 here, and also another spacer "b" at the lower part of Fig. 1.

Q. Now, turn the sheets around so the Court can see the edge view of the sheets.

A. And in addition to these sheets being parallel, they are also with the corrugation going vertical.

Q. Where does the air come in?

A. The air flows in between these sheets and then it flows in an undulating manner through the unit, if these sheets are solid. However, it does specify the sheets are of reticulated metal.

The Court: Reticulated?

The Witness: Reticulated, yes.

The Court: Is that foraminous, the same as foraminous?

The Witness: Yes.

The Court: You mean it has got holes in it?

The Witness: It has holes in it, but reticulated metal, as I understand it, indicates a woven material or a criss-cross material.

And a foraminous material quite often has the connotation of perforated or punctured. But they both have holes in them. [526]

By Mr. Harris:

Q. What else may the sheets be made of?

A. The sheets may be of perforated metal, woven wire, or expanded metal.

It further states that the perforations, the mesh or gauge may be varied. This construction is indicated on page 2, lines 43 to 49.

(Testimony of Kenneth F. Russell.)

The Court: They use water in this, is that it? "(e) is the chamber at the top of the plates with finely perforated floor (f)"——

The Witness: There is a liquid used.

The Court: ——"for delivering clean water on to the filter plates, the clean water entering via pipe (h). (g) is the chamber or tray at the bottom of the plates for receiving the water and debris as they fall from the plates and from which they escape through pipe (i)."

Mr. Harris: Mark this, please.

The Clerk: Exhibit Z being marked for identification.

The Court: All right.

(The sketch referred to was marked Defendants' Exhibit Z for identification.)

The Witness: On page 3, line 17, the description is given of just how the air flows through the unit. [527]

Mr. Harris: In order to illustrate the operation I have marked for identification a sketch which is marked as Defendant's Exhibit Z.

Q. I hand you a copy of the Defendants' Exhibit Z, Mr. Russell, together with the Farr Company catalog which is Defendants' Exhibit E, and ask you to tell the Court what this sketch, Defendants' Exhibit Z, is, what it shows.

A. The sketch shown on Exhibit Z is made at my direction. It illustrates on the left the Farr catalog in so far as possible, which was copied

(Testimony of Kenneth F. Russell.)

exactly from the catalog sheet of Farr entitled Exhibit E. On the right is shown a view of the Row (British) patent illustrated in Fig. 2 and illustrates the direction of the air as it flows through this unit.

The arrow No. 1 in both pictures illustrates the approximate airflow where the filter is clean.

The Court: That is, assuming the Row (British) patent to be made out of open wire material or equally foraminous instead of solid material?

The Witness: Right.

The Witness: Right.

The Court: It claims either in the patent, does it not?

The Witness: I am not too sure of that. As I recall the material—page 2, 43 to 49—no, it states that the improved filter consists of any suitable form of reticulated metal work or preferably sheets of perforated metal or sheets [528] of woven wire, and so forth.

The Court: Very well.

The Witness: As I recall the entire specifications are devoted to a reticulated material.

Line 2 in both drawings illustrates the path of the air through these devices and when some material had accumulated.

By Mr. Harris:

Q. What kind of material?

A. This material would be the dirt or dust that had been transported from the air.

Q. Is that shown on the drawings as anything?

(Testimony of Kenneth F. Russell.)

A. That is shown on the drawings by the dark blue marks or deposits in both illustrations.

Q. Now by the heavy dark blue lines you mean what?

A. The heavy dark blue lines. The wavy dark blue lines are the same as in Fig. 2 and they represent the cross-section of the plates themselves.

The specifications state on page 3, line 17 to 19, it states that the air flows through and impinges upon the numerous surfaces and due to the interstices will be blown up into numerous streams, which indicates that the patent also explains the airflow is partially through the screens and partially through the passages between the screens.

Q. Now continuing your explanation of Defendants' Exhibit Z, the sketch, I think you got to the arrow No. 2 on [529] the right-hand picture.

A. No. 3 and No. 4 arrows on both drawings show the result of the loading of the dust as it accumulates on the air flow as the dust has accumulated deeper into the filter.

Mr. Leonard S. Lyon: If Your Honor please, I move to strike the last answer as no foundation laid. There has been no foundation in the testimony for any dust loading of this British device. The witness hasn't laid any foundation that he has ever seen such a device or pointed out it would have a dust loading capacity.

The Court: I think that objection goes to the form of the question. This is his opinion.

Did you ever make one of these?

(Testimony of Kenneth F. Russell.)

The Witness: No, I did not.

The Court: Did you ever see one?

The Witness: I never saw one.

The Court: By the way, this device requires water in its operation, according to the teachings of the patent, does it not?

The Witness: Yes, it uses water to wet the walls of the screen.

The Court: The water is the thing that cleans the air, is it not?

The Witness: The water washes the dirt from the plates and whether the plate—— [530]

The Court: Does it not say in there that it breaks it up into tiny particles, thus washing the air and dropping it to the bottom?

The Witness: I will check on that.

It states that above the filter is a spray pipe or pipes to deliver water into a tray with a perforated bottom through which the bottom is evenly discharged in a number of small streams under the upper parts of the filter.

My interpretation was——

The Court: On line 22 it states that the layer will be more effectively cooled and relieved of all particles of dust. It says here that the water which wets all the exposed surfaces and which is also broken up and given more extended traverse than usual, thus bringing it into more intimate contact with the air. The air will be effectively cooled and relieved of all particles of dust.

In other words, is the water the cleaning agent in this device or is it the plates?

(Testimony of Kenneth F. Russell.)

The Witness: Well, it is the water that is on the plates that is the cleaning agent. If the plates were not there the water would fall immediately to the bottom.

The Court: Is there any viscous material there?

The Witness: No viscous material. The only wetting is the water itself.

The Court: The only wetting is the water itself. [531]

The Witness: Yes, it is from the water itself.

The Court: Well, is this a self-cleaning apparatus?

The Witness: If the unit were sprayed with water and continued to function, it should.

The Court: There would not be any pressure drop then?

The Witness: The pressure drop should not increase.

The Court: In other words, it would not get dirty because the water would continue to clean the plates?

The Witness: That is correct.

Mr. Leonard S. Lyon: That is my objection, Your Honor. The witness started to say this had a comparable dust loading capacity to these other filters, and he laid no foundation to it.

The Court: I take it that his assumption on Exhibit C is that there would be no water introduced into this.

The Witness: That is correct.

The Court: If there were no water introduced into the flow or through then the air flow would be

(Testimony of Kenneth F. Russell.)

as here and there would not be an accumulation of dust?

The Witness: These would be the regions where the dust would tend to deposit.

The Court: In your opinion?

The Witness: In my opinion.

By Mr. Harris:

Q. Now, Mr. Russell, will you clarify this question [532] of water or oil? Will you compare the use of water or oil in panel type filters so far as just purification is concerned?

The Court: You mean oil introduced through pipe H into tank E and withdrawn through tank G in the British patent?

Mr. Harris: No, Your Honor. I was first going to ask him to compare the use of water as a wetting agent and oil as a wetting agent in any of these panel type filters, the Farr filter or the Air-Maze filter or the Vortox filter or any of them.

Q. What is the difference, if any, in the operation of water or oil or any other liquid?

Mr. Leonard S. Lyon: I object to that on the ground that there is no foundation laid. The witness hasn't laid a foundation for an opinion or stated that he had an opinion.

By Mr. Harris:

Q. Do you have any opinion?

Mr. Leonard S. Lyon: Nor what it is based on.

The Witness: Yes, I have an opinion.

Mr. Leonard S. Lyon: I would like to know what it is based on.

Mr. Harris: Let us get the opinion first and then we can ask him.

(Testimony of Kenneth F. Russell.)

Mr. Leonard S. Lyon: I would like to know what it is based on to see if it is admissible. [533]

The Court: I would not understand it if he expressed his opinion because your question is not postulated on the proposition that oil shall be used the same as water in these cleaning devices. If oil is used the same as water, then if he expresses his opinion it will mean something. If oil is used in a different fashion, that is for merely soaking the paper, such as is done in one of the exhibits, or coating the material, then his opinion would be something else.

By Mr. Harris:

Q. If oil and water are used in the same manner in one of these panel type filters, such as the Farr filter in suit, the Air-Maze filter or any of the others, what would be the comparable results so far as air cleaning was concerned?

Mr. Leonard S. Lyon: I object to that on the ground there is no foundation laid that they could be or have been or that the witness has any knowledge concerning this.

The Court: If he has an opinion—have you ever experimented or tried it?

The Witness: Not in regard to panel filters but using our type of filter element in oil bath units, why, yes, I have observed the action of water and oil.

The Court: If I understand the testimony correctly in this case, the only use of oil in a panel filter unit such as the Farr unit and the Defendants'

(Testimony of Kenneth F. Russell.)

Exhibit P-5 is to coat the material, is that correct?

The Witness: That is correct.

The Court: Now assume that, assume that you washed all that oil off of those elements, or whatever you call them, and coated it with water, would your result be the same? I mean if you just dipped it in water.

The Witness: It would have to be instantaneous because the water would evaporate rather rapidly.

The Court: In other words, you would have to have a continuous water bath?

The Witness: You would have to supply it continuously.

The Court: Then the water would clean the air and clean the filter?

The Witness: Yes.

The Court: And then you would not have any pressure drop?

The Witness: You would not have any increase in pressure drop.

The Court: And you would have more expense in operation?

The Witness: There would be more expense in operation.

The Court: Because you would have to get a water supply and keep it pumping?

The Witness: Yes. [535]

* * * * *

Mr. Leonard S. Lyon: Your Honor, I have the following to be added to Exhibit 17, in accordance with the previous record: a copy of the judgment,

(Testimony of Kenneth F. Russell.)

a copy of the complaint, and a copy of the answer. I ask that they be made part of Exhibit 17.

The findings of fact and the order for the judgment are already part of Exhibit 17.

The Court: Very well. All right.

Mr. Harris: Next, if the Court please, Mr. Watterson, who testified several days ago, calls my attention to an error in the transcribing of some of his testimony, which he would like to have corrected. That is on page 393 of the record, line 20 of that date. The words "air resistance" should be "arrestance," and, with the consent of counsel, may we correct it at line 20? "Air resistance" should be "arrestance." [540]

* * * * *

The Court: All right. If that is what the witness wants to say.

Mr. Leonard S. Lyon: Do you want to use it twice? It is in line 19 and line 20.

The Court: " * * * that showed as low initial resistance"——

Mr. Harris: No. That is a different thing he is talking about.

The Court: " * * * nor have I seen anywhere the"——

Mr. Harris: The arrestance. You will see, if you read the next sentence, "They invariably will slope upward as the [541] dirt loads up the filter and the efficiency increases." That ties in with "arrestance" and not "air resistance."

The Court: Very well.

KENNETH F. RUSSELL

resumed the stand on behalf of the defendants and, having been previously duly sworn, testified further as follows:

The Court: You have finished with the Kirkham patent, have you?

Mr. Harris: First I want to go back to the Manning patent, which is tab No. 9.

Direct Examination—(Continued)

By Mr. Harris:

Q. Mr. Russell, yesterday there was some colloquy and some questions asked by the Court and by myself relative to the Manning patent. At page 495 of the record, the Court asked you this question:

"That is, the Manning patent follows the specifications and drawings—I mean would follow the specifications and drawings of the Manning patent, only substituting the material of the Farr.

"The Witness: My opinion would be that the efficiency would be slightly higher and the restriction might be slightly higher—would be slightly higher.

"The Court: The restriction, the pressure loss?

"The Witness: The pressure drop through the filter would be slightly higher."

Then, continuing on page 496, the first few questions and answers, would you explain what you had in mind when you gave your answers to those questions.

(Testimony of Kenneth F. Russell.)

A. What I had in mind was that, if the Manning—it is rather involved—if the Manning filter were constructed of fly screen as used in the Farr filter, the '479 patent, that the efficiency would be higher and the restriction to the air flow would be higher than the Farr filter. I apparently misunderstood or misinterpreted the question.

The Court: That is what you meant by "resistance"?

The Witness: "Resistance" in place of "restriction."

The Court: Yes.

The Witness: Yes.

The Court: They mean the same thing?

The Witness: They mean the same thing.

The Court: That is what I understood you to mean. [543]

By Mr. Harris:

Q. What would your answer be in answer to the question of the Court relative to the comparison between the Manning device made out of paper and the Manning device made out of fly screen?

A. The Manning device——

Mr. Leonard S. Lyon: I object to that as no foundation laid.

The Court: That is just what he was talking about.

Mr. Harris: No, Your Honor.

May I explain this a bit? Over on page 492 of the record at the bottom of the page, line 25, I asked a question:

(Testimony of Kenneth F. Russell.)

"Q. In your opinion, if these strips 18 and 19, the alternate corrugated and flat strips, were made of wire fly screen, how would the operation of this filter compare with the filter illustrated and described in the '479 patent in suit?"

Now following that we got off on some colloquy there and then Your Honor asked a question, the import of which was to compare the Manning patent with and without fly screen, and that is what the witness answered.

I wanted to clarify that here now so as to answer Your Honor's question the way the witness desires to answer it and not the answer which he gave to the question I asked [544] which he understood Your Honor to ask but which was incorrect.

The Court: You just asked him that question and he answered it again.

Mr. Harris: Yes. Now I want an answer to Your Honor's question.

The Court: He answered: The efficiency would be slightly higher and the restriction might be slightly higher. Now he says restriction and resistance to the air.

The Witness: Yes, Your Honor. I said that the efficiency would be slightly higher and the restriction or resistance to the air would be slightly higher than the Farr filter.

The Court: Than the Farr filter?

The Witness: Than the Farr filter. That is where I got off on the wrong track.

(Testimony of Kenneth F. Russell.)

The Court: I understood you to say that it would be slightly higher than the Manning filter made out of paper.

Mr. Harris: That is what he did say, but he was thinking that Your Honor was asking the question which I had previously asked.

Q. Now what is your answer to His Honor's question?

A. May I have the question?

Q. I will read it.

Mr. Leonard S. Lyon: Your Honor please—I will wait until you have read the question. [545]

By Mr. Harris:

Q. Here is the question——

The Court: "Assuming that the Manning device were made of wire screen material such as used in the Farr patent, do you have an opinion as to whether or not the results would be the same or better or worse than if the Manning patent were made of the material described in the patent?" That was my question.

* * * * *

The Witness: If the Manning filter were constructed of fly screen then the efficiency would be slightly higher than [546] if constructed of paper and the restriction would be about the same. It could possibly be slightly lower or higher. I wouldn't know definitely without test.

By Mr. Harris:

Q. Now referring to the Wood patent, which is tab 11 in Defendants' Exhibit C, will you state

(Testimony of Kenneth F. Russell.)

what that patent teaches as to the use of oil or water in a panel type filter?

A. The Wood patent teaches on page 7, first on lines 23 to 30——

Q. What column?

A. Page 7, column 2, lines 23 to 30, it states:

"The baffle plates may be of corrugated paper coated with a viscous oil or other viscous material. Where the filter unit is to be discarded after use or the baffles may be of sheet metal, for example, sheet copper, where the unit is used and then washed and recoated with viscous material for reuse in the system or when the unit is continuously flushed with an oil or water spray * * * "

The patent goes on to state or teach, on the same page, page 7, column 2, lines 52 to 71:

"For the throwaway type of the permanently coated unit the surface of the corrugations may also be coated with a mucilaginous compound composed of gum, water and a microscopic agent [547] capable of drawing water from the air so as to maintain the coating moist may be used. Where the unit is permanent the coating can be flushed off when it becomes loaded with dirt and recoated by spraying or dipping for the next period of operation. In some instances I prefer to use a continuous spray of drip of oil or water in the unit to provide the desired viscous coating, and also to flush the collected dirt into a sump. For such installations a spray or drip of oil or water is applied continuously to the upstream face of the unit when

(Testimony of Kenneth F. Russell.)
the latter is in the vertical position and the residue permitted to drip from the base of the unit into a sump. A recirculation of the oil or water may be afforded if desired by using a suitable pump."

Q. Now will you summarize what that means to you as to the relative use of oil or water in such a filter?

A. To me that indicates that water or oil may be interchanged as a coating on a filter element so far as trapping the dust particles that are carried in the air.

I believe it also indicates that the water has an additional function to wash away that coating if the water is supplied in sufficient quantities.

Q. Would you say that the action of such oil and water [548] is the same or different?

Mr. Leonard S. Lyon: I object to that. There is no foundation laid.

Mr. Harris: I will ask that, based upon your experience.

Q. What experience, if any, have you had, Mr. Russell, with the use of oil and water in air filters or cleaners?

A. I have had some experience in air cleaners where we have substituted water for oil and we have found the functioning to be very similar.

* * * * *

The Witness: The air cleaners that I have in mind or that I am talking about are those cleaners where we use the same type of filter element as we do in our panel filters.

(Testimony of Kenneth F. Russell.)

By Mr. Harris:

Q. In your panel filters, are they oil coated?

A. Yes, we recommend that they be oil coated.

Q. Such as illustrated by the Defendants' Exhibits S and T in evidence here? [549]

A. That type of filter, yes.

Q. And what is the action of the oil in those filters so far as dust removal is concerned?

A. The surface of the oil is that upon which the dust impinges. The oil is to take the dirt out of the air.

Q. Now referring to the Row (British) patent, tab 13 in Exhibit C, what is the function of the water used in that patent?

A. The function of the water in the Row patent—first, the application of the water is described on page 3, lines 9 to 15, where it states that the water is sprayed onto the upper parts of the filter, and the purpose of the water here is to provide a surface to which the dust can adhere after it has impinged, and it also has a second function in this patent of washing the dirt off of these filter elements down into a sump.

Q. Now in the Row patent, referring to Fig. 2 of the drawings, what does the patent say about the flow of air through the device, and by that I mean does it indicate whether the air flows down between the corrugations or does it flow through the screens, or how does it flow according to the patent?

A. The patent, on page 3, line 17, indicates that the air flows through the screens. The arrows on

(Testimony of Kenneth F. Russell.)
Fig. 2 indicate that some of the air flows, at least some of the air flows, [550] along the passages or along the surfaces of the screen.

Mr. Harris: Does your Honor have any further questions on the Row patent at this time?

The Court: Not at this time.

By Mr. Harris:

Q. Mr. Russell, will you turn next to the Moller (British) patent, tab 14, being Patent No. 211,756, and briefly describe the device illustrated there?

A. This device is titled "Improvement in or Relating to Air Filters." The device is shown on Fig. 1 and Fig. 2. It is an air filter, as stated on page 1, column 1, line 11: "This invention has reference to air filters."

It is in the form of a belt or chain type of unit and consists of a series or a number of sections, indicated as K in Fig. 1, which are connected together to form this belt or chain. The unit moves over a drum at the top of Fig. 2 and also around a drum, around the bottom of Fig. 2.

The air flow is indicated on drawing 2 as from left to right, which would be on Fig. 1 perpendicular to the face as it is shown there.

The patent goes on to describe and illustrate the individual sections K, the construction of the individual sections K, and these sections consist of numerous plates and these plates are parallel to the air flow.

The individual plates are shown on Fig. 3 and 4 and the [551] drawings and specifications also in-

(Testimony of Kenneth F. Russell.)

dicate that the plates are formed on so as to produce projections or corrugations.

Q. What is the form of those corrugations?

A. These corrugations are V-shaped, as may be seen in Fig. 3 and 4. They are indicated as F.

Q. How are those plates assembled?

A. These plates are assembled immediately adjacent to each other, and on page 1, column 2, line 58 to 64, it indicates that the plates are reversed end to end so that the V-shaped projections, or the V of the projections, are in opposite directions.

This of course prevents the plates from nesting and provides a space between plates for the air passage.

Q. How does that compare with the filter media of the Air-Maze P-5 construction as illustrated by Plaintiff's Exhibit 6?

The Court: How does what compare, the plate?

Mr. Harris: The disclosure of this patent, the way the plates are assembled.

The Court: The way the plates are assembled or the plates themselves or the whole things?

Mr. Harris: The way the plates are assembled first.

Mr. Leonard S. Lyon: I don't think the witness has described how they are assembled.

The Court: It is not clear to me yet just how they are [552] assembled.

By Mr. Harris:

Q. Will you describe that in some more detail, Mr. Russell?

(Testimony of Kenneth F. Russell.)

The Court: He says that Fig. 5 shows a chain link inside view.

The Witness: Fig. 5 is an enlarged view of a section of a portion of this section indicated as—well, one of the sections such as indicated by K in Fig. 1.

The view in Fig. 5 shows the plate shown in Fig. 3 and Fig. 4 placed together with what I would call hinge pins at top and bottom.

By Mr. Harris:

Q. Lettered what?

A. These are lettered D-D and D.

The plates are assembled, enough of them are assembled together—there are only a few shown in Fig. 5 but enough are assembled—to completely cover the opening in this filter unit. That is completely across Fig. 1 as shown by the small vertical lines. Each line there represents one plate. Each little vertical line represents one plate.

Q. Well, now, again how are the plates shown in Fig. 3 and 4 assembled relative to each other?

The Court: Alternating, he said.

The Witness: They are placed side by side.

The Court: Side by side?

The Witness: With the corrugations of one touching the adjacent plate.

The Court: That would be on top of one another, would it not?

The Witness: Yes. Looking at it this way, it would be (illustrating), but they are assembled in a manner across like this and the air flows through here.

(Testimony of Kenneth F. Russell.)

The Court: The air flows how?

The Witness: The air flows between the plates. They are spaced, numerous of these plates are spaced across as shown in Fig. 1. Then there is a hinge pin across the top and a hinge pin across the bottom and the entire unit acts as a belt. It travels up over the drum at the top.

By Mr. Harris:

Q. What is the direction of air flow relative to the direction of the plates?

A. Generally it is parallel to the plates, the general direction. However, it is diverted by the corrugations so it is a tortuous path. [554]

The Court: And in operation, the link chain filters dip down into a pan of water?

The Witness: Into a liquid, and this liquid will coat the plates so that they have a surface adapted to hold the dust particles.

The Court: What does it say in the patent? "* * * such projections constituting pockets or troughs for collecting a suitable wetting and dust retaining adhesive liquid,"——

Mr. Leonard S. Lyon: Page 2, line 22, in the first column, your Honor.

The Court: Yes.

The Witness: Also page 1, column 1, line 40, and so on.

By Mr. Harris:

Q. Is that link chain construction designed to be moved fast or slowly?

(Testimony of Kenneth F. Russell.)

A. As I recall it, it doesn't state specifically in the patent, but, from my experience, my opinion would be that it would move relatively slow.

Q. Now, what is the purpose of making the plates, assembling them so that the plates are herringbone and then reversing the alternate plate?

The Court: He says the purpose of it is "for collecting and for scooping up the wetting liquid in the receding angles of the V."

By Mr. Harris: [555]

Q. What does the patent say about that, Mr. Russell?

The Court: Page 1, line 30?

A. On page 1, lines 30 to 35:

"In accordance with the invention these small aminary plates are provided with projections arranged at an angle to the direction of the air current, and forming obstructions by means of which repeated deviations of the paths of the current is produced,"——

By Mr. Harris:

Q. Now, in your opinion, if this device were made of wire fly screen, if these plates were made of wire fly screen instead of perforated metal plates, how would the operation of that device compare with the operation of the Air-Maze P-5 panel?

Mr. Leonard S. Lyon: If your Honor please, may I have voir dire on this?

The Court: Yes.

(Testimony of Kenneth F. Russell.)

Voir Dire Examination

By Mr. Leonard S. Lyon:

Q. Have you ever seen a device constructed or operated according to the disclosures of this patent, tab No. 14?

A. In its identical construction, no.

Q. Can you tell us from this patent how fast this endless chain moves in the operation of the device?

The Court: From the patent? [556]

Mr. Leonard S. Lyon: Yes.

A. No. As I said before, I do not recall of any reference to the speed, the exact speed, of the device.

The Court: Well, does it say fast or slow, or does it say anything about the speed?

The Witness: I don't recall a reference to it.

The Court: As a matter of fact, it doesn't, does it?

The Witness: I don't think it does.

By Mr. Leonard S. Lyon:

Q. Now, it says at line 25 on page 2, column 1, "pockets or troughs for collecting and for scooping up the wetting liquid in the receding angles of the V." Can you tell us from the patent how full those V's are in the normal operation of this device?

A. I don't understand what you mean by "how full." Do you mean when they immediately leave the liquid or when they go up over the top?

Q. Are they full of water when they go up?

(Testimony of Kenneth F. Russell.)

A. As they go up to the top, depending on how tight the plates are. The patent doesn't distinctly show there.

Q. Could you tell from the patented filter?

A. No. I couldn't tell from the patent.

* * * * * [557]

By Mr. Harris:

Q. Well, Mr. Russell, I will ask you that. Couldn't the plates illustrated in Figs. 3 and 4 of the Moller patent [558] be formed out of wire fly screen?

Mr. Leonard S. Lyon: The same objection.

The Court: Objection overruled. In his opinion.

A. In my opinion, the plates could be formed out of fly screen, yes.

By Mr. Harris:

Q. And could they be assembled, if so formed, in the manner illustrated in this patent?

Mr. Leonard S. Lyon: The same objection.

The Court: Objection overruled.

A. In my opinion, yes, they could be assembled in this manner.

By Mr. Harris:

Q. Now, if they are so formed or assembled, what is your opinion as to the comparative operation of this device so far as removing dust from the air, and the operation of the Air-Maze P-5 panel in suit?

Mr. Leonard S. Lyon: The same objection.

The Court: Objection overruled.

A. The operation would be similar to that of the

(Testimony of Kenneth F. Russell.)
patent shown in Exhibit 6, which I understand is the P-5 filter in question.

The Court: Well, do you have an opinion as to how long these screen wires or this screen material would last, by being subjected to the screen running over the drum, possibly? [559]

The Witness: There would be a question as to the life of it. I don't think they last too long, unless they are reinforced either at the top or the bottom of the hinges, so far as the matter of construction is concerned.

Mr. Harris: I produce a certified copy of a translation of the French patent to Niestle, No. 739,956, which I ask be marked for identification as Defendants' Exhibit AA.

(Said document was marked Defendants' Exhibit AA for identification.)

* * * * *

The Court: All right.

(The document referred to, marked Defendants' Exhibit AA, was received in evidence.)

[Printer's Note: Defendants' Exhibit AA is reproduced in Book of Exhibits.]

By Mr. Harris:

Q. Now, Mr. Russell, will you turn to the Niestle patent and the translation that is found in the prior-art [560] book, Defendant's Exhibit B, and briefly describe that to the Court?

A. The Niestle patent describes a filter for removing dust from gases. It is shown in Fig. 1—

(Testimony of Kenneth F. Russell.)
section of the filter is shown in Fig. 1, and an alternate construction is shown in Fig. 5.

The filter is constructed with three air passages from the upstream to the downstream and, considering the form shown in Fig. 1, the filtering element is fabricated from sheets of material and so arranged and in such a manner that they form passages as shown by the dotted lines $4^1$ and $4^2$. The sheets that I spoke of, and that had been fabricated in this manner, are indicated as $3^1$. The second sheet is $3^2$, $3^3$, and $3^4$.

The embodiment shown in Fig. 5 shows a different relation of these elements of the filter, these sheets of the filter. They have been arranged to form—the passages, for instance, $3^1$ and $3^2$ have been assembled in the same direction to increase the length of the passage before the bend is made.

Figure $3^3$ and $3^4$ shows the unit reversed, to give a change in direction of the air flow.

Q. What are the dotted lines with the arrows on them in Figs. 1 and 2?

A. The dotted lines in Fig. 1, with the arrows on them, $4^1$ and $4^2$—just the dotted lines—I am sorry. [561] Correction. $4^1$ and $4^2$ refer to an element of the screen.

The dotted lines refer to the direction of the passages.

Q. What is shown in Figs. 6, 7, and 8?

A. Fig. 6, Fig. 7, and Fig. 8 show the sheets of material before they have been formed. It merely shows them. For instance, Fig. 6 shows a wire

(Testimony of Kenneth F. Russell.)

screen material or a wire gauze material as described—as shown in the patent, metal gauze.

* * * * *

The Witness: The material shown in Fig 6 is described in the patent as metal gauze.

The Court: Whereabouts?

The Witness: On page 5.

Mr. Leonard S. Lyon: Is that the translation?

The Witness: Of the translation, yes. Page 5, paragraph 2, "In particular, according to one embodiment of the elements $3^1$, $3^2$ are cut out and pressed in a metal gauze 6 (Fig. 6)."

Mr. Harris: I produce a sheet of material which I ask be marked as Defendant's Exhibit BB.

(Said material was marked Defendants' Exhibit BB for identification.)

The Court: The patent says, "The meshes of the metal gauze may be fine enough for the liquid, such as oil, applied thereon to fill the meshes by capillary action and form a continuous, thick film of oil, favoring the deposition of the dust suspended in the gas."

The Witness: Yes, your Honor.

The Court: Does it or does it not state that the openings in the gauze should be small enough so that when dipped in oil they form a solid plate composed of the screen and the oil filling the holes?

The Witness: As described there, it does.

By Mr. Harris:

Q. Does the specification indicate that it necessarily is so formed?

(Testimony of Kenneth F. Russell.)

Mr. Leonard S. Lyon: I object, your Honor, unless the witness can point to it.

The Court: Objection sustained.

By Mr. Harris:

Q. I show you Defendants' Exhibit BB. [563]

The Court: What was AA?

Mr. Harris: A certified copy of the French patent.

The Court: Oh, yes.

By Mr. Harris:

Q. Will you identify that exhibit, Mr. Russell?

A. Exhibit BB illustrates the sheet shown in Fig. 6 of the patent.

Mr. Harris: Next I produce another sheet of material.

The Court: Have you seen it?

Mr. Leonard S. Lyon: Yes, sir, I have, your Honor.

Mr. Harris: Which I ask be marked as Defendants' Exhibit CC.

(Said sheet of material was marked Defendants' Exhibit CC for identification.)

The Court: Of what gauge, or how would you describe this Exhibit BB, how many perforations to the inch?

The Witness: I would assume this was approximately 30 openings to the inch.

The Court: No. 30 gauze, you call it wire gauze. All right.

By Mr. Harris:

Q. I will show this to counsel first, and then I

(Testimony of Kenneth F. Russell.)
show you Exhibit CC for identification. Will you identify that, Mr. Russell?

A. Exhibit CC illustrates the material as it is formed [564] and shown in Fig. 1 as, for instance, the element $3^1$, or shown in Fig. 2 and Fig 3 in a side and an end view.

Mr. Harris: Exhibit BB is offered into evidence to illustrate the witness' testimony.

* * * * * [565]

The Court: The objection is overruled. It is admitted.

(The article referred to was received in evidence and marked Defendants' Exhibit BB.)

Mr. Harris: The next one we offer is the expanded metal Exhibit CC as Defendants' Exhibit of the same number.

The Court: Admitted.

Mr. Leonard S. Lyon: Same objection, your Honor.

The Court: Same ruling.

(The article referred to was received in evidence and marked Defendants' Exhibit CC.)

Mr. Harris: I have here another model which I think plaintiff's counsel have seen previously, but I will let them inspect it again.

(Exhibiting device to counsel.)

By Mr. Harris:

Q. This has been marked as Defendants' Exhibit DD, Mr. Russell. Would you identify that?

(Testimony of Kenneth F. Russell.)

The Court: I do not understand your answer to the last question concerning CC, before we get to that. The patent says the meshes may be fine enough with a liquid such as oil applied thereon to fill the meshes by capillary traction for [566] a continuous thick film of oil. In other words, the meshes would be filled but these slips would remain open?

The Witness: Yes, your Honor.

The meshes would be in actual practice—it would be my opinion—that whether the meshes were filled with oil would depend upon the temperature of the oil and the viscosity that was used.

The Court: It says to fill it so that the meshes will be filled.

The Witness: But that would be the fine mesh, of course, and not the opening that they are referring to.

Mr. Harris: It says they may be. It does not say they have to, if I may call your Honor's attention to that.

The Court: I see.

* * * * *

By Mr. Harris:

Q. Mr. Russell, will you now identify the Exhibit DD.

A. Exhibit DD illustrates the device as shown in Fig. 5.

Q. Of the Niestle patent? [567]

A. Of the Niestle patent.

Q. And will you point out what it includes so far as the wire screen members are concerned?

(Testimony of Kenneth F. Russell.)

A. It includes several sheets of the material fabricated as described in the patent and assembled so as to form passages having walls of a mesh material.

Mr. Leonard S. Lyon: Your Honor please, may I understand if the witness is testifying that this Niestle patent describes the use of the material in Exhibit DD? He said so but I don't think he meant to and I don't want to encumber the record.

The Court: That will encumber the record?

Mr. Leonard S. Lyon: Yes, already heavily encumbered.

I would like to know if the witness means to testify that the Niestle patent describes the use of wire screen such as in Exhibit DD.

The Court: I thought that is what he testified to. You said that is built according to the teachings of the Niestle patent?

The Witness: I said this device illustrates the embodiment——

Mr. Leonard S. Lyon: You said the material described in the patent.

The Witness: I said this device, the particular device that I am talking about, DD, illustrates the embodiment of [568] the invention that is shown in Fig. 5 of the Niestle patent.

Mr. Leonard S. Lyon: I object to that as a legal conclusion rather than a statement of fact.

The Court: It is his opinion. He is an expert.

By Mr. Harris:

Q. Now as to the device illustrated in Fig. 5 of the Niestle patent, and described in the Niestle

(Testimony of Kenneth F. Russell.)

patent, are there or are there not passages which extend from front to back or from front face to rear face of that filter device?

A. Yes, there are.

Q. Do those passages subdivide the flow of fluid, in your opinion, in both dimensions perpendicular in the general direction of flow?

A. Yes, they do.

Q. In your opinion, in the Niestle construction are the passages so constructed and arranged that as the mesh members become progressively clogged the medium to be filtered may flow through such passages and encounter unclogged mesh members?

A. Yes.

Q. In your opinion, in the Niestle construction do the passages through the filter from front to back change in direction as they pass through the filter? A. Yes.

Q. Are such changes in direction abrupt? [569]

A. Yes, the changes are abrupt. They are as abrupt as shown and described in the '479 patent.

Q. Now based upon your experience in the air filter art, please state your opinion as to how the air would flow through the device illustrated in the Niestle patent.

Mr. Leonard S. Lyon: I object to that, Your Honor, and I would like to have a voir dire.

The Court: Yes.

Mr. Leonard S. Lyon: Have you ever seen a device or tested a device such as illustrated in the Niestle patent?

The Witness: No.

(Testimony of Kenneth F. Russell.)

Mr. Harris: Seen or tested, was that the question?

Mr. Leonard S. Lyon: Yes.

The Witness: I have seen the model.

The Court: That is this model?

The Witness: Yes.

Mr. Leonard S. Lyon: Have you tested that model?

The Witness: I have never tested that model.

The Court: Is this built according to the teachings of the patent? What are all these little wells in here. I have been trying to find out how there is one continuous sheet of this material, and it does not appear to have any. They are welded together some place. Is that what those welds are?

The Witness: Yes.

The Court: Where is the one sheet in this model here [570] that goes across such as is shown here in Fig. 6 or like BB or CC?

The Witness: If you look at the model in this manner (indicating), this would represent the view of Fig. 5 and this would be the left side and this would be the right side, and the dotted arrows shown there would be through here and through here. (Indicating.)

The Court: You have all that on the end, but that is not one piece of metal.

The Witness: The one sheet of metal consists of from this point to the left. It is one sheet of metal from there. The sheet of metal from here—this is from here to here—and that is the second sheet,

(Testimony of Kenneth F. Russell.)
and the third sheet is this material here, the fourth sheet is this section here, and this consists of five sheets, as I read it.

The Court: Is that big enough to test for practical purposes?

The Witness: In my opinion, no. [571]

* * * * *

By Mr. Harris:

Q. Does it make any difference, Mr. Russell, which one of these various materials illustrated in the patent are used so far as the air flow is concerned? A. To a degree, it would. [572]

* * * * *

The Court: By the way, in that Exhibit DD, is the screening material or media the same as Exhibit CC and BB?

The Witness: I would have to examine them, sir, to see.

The Court: Or is that 14 mesh?

The Witness: No, this is not 14 mesh. This is about 16 mesh in one direction, about 16 x 16, or 18 x 18, somewhere below 20.

By Mr. Harris:

Q. You are referring to Exhibit DD?

A. I am referring to Exhibit DD. [574]

* * * * *

Mr. Harris: Very well.

Q. Mr. Russell, assuming that the device in the Niestle patent is made of wire gauze as described in the patent, will you explain your opinion as to the nature of the flow of air through that device?

(Testimony of Kenneth F. Russell.)

Mr. Leonard S. Lyon: I object to that as no foundation laid, also as failing to state whether or not the perforations in the wire gauze, the meshes of the wire gauze, are fine enough so that the liquid or oil applied there to fill the meshes and form a continuous thick film of oil.

The Court: You can cross-examine him on that when you get to it. He has a right to frame his question according to his theory and as long as it is approximately fair—and it is—the objection is overruled.

The Witness: The answer would be that some of the air would flow through the screens and some of it would flow along the surface of the screens.

By Mr. Harris:

Q. What is your opinion as to the deposition of dust during that air flow?

Mr. Leonard S. Lyon: Same objection.

The Court: If the screen holes were filled with oil [575] so that the air could not get through, would it flow through the screen?

The Witness: There is a fine point there. I was assuming—the patent says that it may be fine enough for the liquid such as oil and applied thereon to fill the meshes. If the screens were so fine, you could get it so fine, and he used a very thick and heavy oil, then obviously if the screens were filled and the pressure drop, the velocity of the air was not great enough to break open those openings, then all of the air would flow along the surfaces of the screens.

(Testimony of Kenneth F. Russell.)

The Court: And the passages?

The Witness: Along through the passages.

The Court: Rather than through the openings of the screen?

The Witness: Yes, sir. But since I base my answer upon the fact that since it says that it may be fine enough for the liquid, I was assuming that we might use in this unit an oil of a viscosity similar to that being used at the present time on other panel filters, such as this oil that was described in our tests, and it doesn't specify in the patent the exact mesh of the gauze and with the latitude that is allowed there you can go from one extreme to the other. If you have a solid impervious wall of oil that cannot be disturbed then the airflow would be through the passages. If [576] the openings of the mesh were allowed, if you went to the other leeway in the patent and used a little larger mesh, and you used a viscosity of oil that we are using at the present time, then the answer I made was based upon that. [577]

* * * * *

Cross-Examination

By Mr. Leonard S. Lyon:

Q. Mr. Russell, you have testified that you know of no agreement between Air-Maze and your company. Have you any agreement with Air-Maze?

A. No. I have no agreement with Air-Maze.

Q. Do you expect to be paid for testifying in this case? A. I hope so.

Q. Well, whom do you expect to be paid by?

(Testimony of Kenneth F. Russell.)

A. The connection I have had is with Mr. Harris.

Mr. Harris: We will stipulate that Air-Maze is going to pay him for his services here. [578]

* * * * *

The Court: What is the bulk of your business?

The Witness: The bulk of our business is in oil bath, air cleaners for heavy-duty equipment such as ordnance tanks, large engines built by Cooper, Bessemer, and Clark Brothers, and that sort of thing, and used by Le Tourneau, and so on.

By Mr. Leonard S. Lyon:

Q. Is your answer the same as to filters like Exhibit S which you say are competitive with the Airkleen device of Air-Maze?

Mr. Harris: "Airkleen" device?

A. I don't know of an Airkleen device.

Mr. Harris: You mean clean-air device?

Mr. Leonard S. Lyon: You had a trade name.

Mr. Harris: Kleenflo.

Mr. Leonard S. Lyon: Kleenflo device?

The Witness: I didn't get your question. [579]

By Mr. Leonard S. Lyon:

Q. Can you tell us what the net sales and receipts have been for your company from the manufacture of air filters like Exhibit S? Exhibit S is the one that you said was competitive with Air-Maze P-5.

A. Yes, I know Exhibit S. We manufacture three different types of filters, in various sizes.

No, I would hesitate, frankly, to even estimate

(Testimony of Kenneth F. Russell.)

what the volume is. As I say, it is a small percentage of the total volume of business of Vortox. To explain that further, if I may, sir, the sale of Vortox panel filters has been confined to the local area. We have one distributor in Los Angeles and, due to shortage of materials in the past, we have hesitated in going any further than that. However, recently we have established a distributor in Texas, where we expect to do some business.

Q. Will you turn now to Exhibit 1 in the prior-patent book?

The Court: Are you offering the book of prior art in evidence?

Mr. Harris: Yes, I will offer it now. Defendants' Exhibit B is offered into evidence.

The Court: It is admitted.

(The book of patents referred to, marked Defendants' Exhibit B, was received in evidence.) [580]

By Mr. Leonard S. Lyon:

Q. Now, with respect to item 1 in that book, the St. Cyr patent, have you ever seen a wire mesh, a wire gauze strainer used in a carburetor or between a carburetor and an engine?

A. No, I don't believe I have seen a wire mesh unit or wire gauze. Pardon me. I did not intentionally do that. Wire——

Q. You don't know about the use of that material as strainers in carburetors, have no knowledge of it?

(Testimony of Kenneth F. Russell.)

A. You did not say a strainer in a carburetor. You said a device between the carburetor and the engine, sir, or did I misunderstand you?

Q. Or in a carburetor.

A. In a carburetor?

Q. Yes.

A. Why would it be in a carburetor? It depends——

The Court: Did you ever see it any place in a carburetor or in a carburetion system?

The Witness: Strictly speaking, I have seen filter devices that filter the gasoline that flows into the carburetor bowl, and those filtering devices consist of what we call strainer cloth and what is illustrated in various catalogs as strainer cloth.

By Mr. Leonard S. Lyon: [581]

Q. What mesh is that?

A. Strainer cloth in a catalog is listed and starts in at probably 30, 40 mesh, and it might go down to 60, 70 mesh per inch.

The Court: It is a very fine mesh?

The Witness: Quite fine, sir.

By Mr. Leonard S. Lyon:

Q. Now, have you ever seen any wire cloth or any wire mesh used as a vaporizer element?

A. No, sir, I have not.

Q. In a carburetor?

A. No, sir, I have not.

Q. Referring to the Farr patent, item No. 10 in the book of patents, have you ever seen any of the devices manufactured by the Farr Company under that patent?

(Testimony of Kenneth F. Russell.)

Mr. Harris: You mean like shown in that patent?

Mr. Leonard S. Lyon: Yes.

A. I don't recall of seeing a device as manufactured in accordance with these patent drawings.

Q. In your opinion, how fast would the device shown in Fig. 3 of that patent be rotated in operation?

A. In my opinion, the device should be rotated relatively slow.

Q. How fast?

A. It would depend upon the diameter of the unit, how [582] large the unit is. If you had a relatively small unit——

Q. How large are they, do you know?

A. I understand they run from a foot or so in diameter and go up to several feet.

Q. Now, tell us, beginning at one diameter and leading through the others, what in your opinion their speeds of rotation are.

A. Maybe I can simplify it. In my opinion, I would supply the unit with approximately one to two feet a minute for a peripheral speed.

Q. How many revolutions per minute or how much of a revolution per minute?

A. Well, if the device were one foot in diameter, then, that would be three and a seventh feet around, so therefore it would take a little over three minutes to make a revolution on that device.

Q. Is that your understanding of the way this device operates, as shown in this patent?

A. No. That is my opinion of how it would.

(Testimony of Kenneth F. Russell.)

Q. Can you tell us how it operates, from the patent?

A. Yes, it states in the patent that it is a rotating device, it rotates on a shaft.

Q. Does it state how fast it rotates?

A. No, it doesn't state how fast.

Q. Can you see through the filter member of this [583] patent?

Mr. Harris: Well, he says he never saw one.

A. I never saw one.

By Mr. Leonard S. Lyon:

Q. Do you think you could see through it?

A. The patent doesn't state at what angle the corrugations are made, so it would depend on that, and it doesn't say how thick the filter is.

Q. Well, based on your opinion as an expert in this art, would you expect to be able to see through it?

A. Since it says somewhere in the patent something to the effect that with the device they want to prevent water from being carried on in the air stream, it would be my opinion that it would be advantageous to make it so you could not see through the unit.

Q. I show you a photograph of a filter member and ask you if you can see through that?

Mr. Harris: May I see that, counsel?

Mr. Leonard S. Lyon: Excuse me.

The Court: See through the photograph?

By Mr. Leonard S. Lyon:

Q. (Continuing) See through the filter member?

The Court: What will be the next number?

(Testimony of Kenneth F. Russell.)

The Clerk: No. 26.

The Court: 26? [584]

The Clerk: Yes, sir.

(The photograph referred to was marked Plaintiff's Exhibit No. 26 for identification.)

* * * * *

The Witness: Well, on the photograph, Exhibit 26, it appears to be that you can see through the passages as shown in one section of it.

By Mr. Leonard S. Lyon:

Q. Can you tell whether or not that filter member, as it appears in that photograph, is constructed in accordance with the teachings of the Farr patent that I have just identified? [585]

* * * * *

The Witness: It appears that this is a section of the filter element constructed in accordance with the '480 patent.

By Mr. Leonard S. Lyon:

Q. Now, when you refer to Fig. 1 of this Farr patent, do you understand that the filter member shown in that patent rotates and that its lower side is immersed in a reservoir of water? [586]

A. That was my understanding.

Q. Can you tell us what the dust-load capacity of such a filter would be?

A. No. I would hesitate to state.

Q. Why?

A. Because I have already testified, I haven't seen one of these units. Besides, you haven't specified as to the size of the unit, the thickness of it, or all the other dimensions.

(Testimony of Kenneth F. Russell.)

Q. Would a device such as illustrated in Fig. 1 of the Farr patent in question have a dust-loading capacity, in view of the fact that the under side of the device rotates through a bath of water?

A. Yes, it could have a dust-loading capacity, if you include in the category of dust various lints and so on that might not be easily washe doff, but by merely dipping a piece of fabric or screen, or whatever this is made of, into a tank of liquid and bringing it out, this is not a violent action apparently.

Q. Would that be the type of dust-loading capacity that is referred to in connection with an air filter panel like Exhibit 2 and Exhibit 6?

A. What? I did not get the question.

Q. This supposed capacity that you say might be had by the Farr device, of Fig. 1 of the patent No. 2,286,480. [587]

A. Well, so far as capacity, I am not too sure of just exactly what is meant. If you mean would the dust accumulate—my answer was that lint possibly could accumulate on this unit and not be washed off, and if it wasn't washed off, it would accumulate.

Q. Would you expect it to be cleaned from time to time, the unit shown in Fig. 1 of Patent No. 2,286,480?

A. As I have testified, I haven't seen one of these units, but based upon my knowledge of similar units, I believe that at periods you would have to remove some lint from this unit.

* * * * *

## FRANK B. ROWLEY

called as a witness on behalf of the defendants, being first duly sworn, was examined and testified as follows:

The Clerk: State your name in full, please.

The Witness: Frank B. Rowley.

The Clerk: And your address?

The Witness: Excelsior, Minnesota. [588]

### Direct Examination

By Mr. Baldwin:

Q. Will you state your age and present position or occupation?

A. I am 69 years old and Professor Emeritus, Mechanical Engineering, University of Minnesota, and consulting engineer.

Q. Will you state what your education has been?

A. I am a graduate——

The Court: What was your position, did you say?

The Witness: Consulting engineer and Professor Emeritus of Mechanical Engineering, University of Minnesota.

The Court: Now your experience, he asked you.

Mr. Baldwin: Education.

The Witness: My education was Bachelor of Science, mechanical engineering, University of Wisconsin, 1905.

I have a professional degree of mechanical engineering in 1906 from Wisconsin.

(Testimony of Frank B. Rowley.)

By Mr. Baldwin:

Q. Will you state your occupational and professional experience for the past 40 years?

A. I have been with the University of Minnesota for over 40 years on the engineering faculty through the various positions of instructor, up to Professor of Mechanical Engineering, and when I retired in 1950 I was head of the [589] engineering department and director of the engineering experiment station.

During my work at the university I also carried on consulting engineering work for over 40 years in various fields of mechanical engineering, a large amount of it in air conditioning, air filters, and so on.

I also conducted research in those fields throughout the period I was there; published a good many papers, at least over a hundred, in the various fields of mechanical engineering.

Q. Do you belong to any professional societies?

A. Yes. I am a member of several. I am a life member of the American Society of Heating and Ventilating Engineers, a life member of the American Society of Mechanical Engineers, a life member of the Minneapolis Engineers Club.

I am a member of the American Society of Refrigerating Engineers. I am a member of the Minnesota Association of Professional Engineers, the National Association of Professional Engineers, a member of the American Society for Engineering Education, and a fellow in the American Associa-

(Testimony of Frank B. Rowley.)

tion for the Advancement of Science, a registered professional engineer in Minnesota.

Q. Have you held any offices in any of these societies?

A. Yes. I have held several offices, including the [590] president of the National Society of the American Society of Heating and Ventilating Engineers.

Q. How long ago was that?

A. 1932, I believe.

Q. Are you listed in any bibliographies?

A. Yes.

Q. Could you name them?

A. Who's Who in America and Who's Who in Engineering, and American Men of Science.

Q. Could you state briefly your experience in the testing and evaluating of air filters?

A. I have been working with the testing of air filters and dust, in that field, as part of my work, for the past 25 years. I was working on the development of the code for testing which was adopted by the American Society of Heating and Ventilating Engineers when that was adopted, a member of the committee.

Q. What year was that?

A. 1933, I believe.

And I have done research work, a large amount of research, to determine some of the fundamental properties of air filters and dust in the air.

I have also done a considerable amount of consulting work for various companies, including

(Testimony of Frank B. Rowley.)

development of air filters, testing of air filters, and so forth. [591]

The Court: Have you ever studied smog?

The Witness: I am getting that here.

By Mr. Baldwin:

Q. What is your connection with this action of Farr Company v. Gratiot and Air-Maze Corporation?

A. I was retained by the Air-Maze Company for testing filters.

Q. Have you ever been employed previously by Air-Maze Corporation in any capacity?

A. No.

Q. Is there any method of testing filter panels of the Farr type and the Air-Maze P-5 type which has been generally accepted throughout the air filter industry?

A. The weight method has been more generally accepted than any other. That is the comparison of the weight of the dust taken out to the dust fed.

There are other methods that have been proposed but there is no one method I think that has been generally accepted by all filter manufacturers in all details.

Q. What in your opinion is the most generally accepted?

A. I think the weight method that is adopted by the American Society of Heating and Ventilating Engineers.

Q. Is that embodied in a code or any such thing?

(Testimony of Frank B. Rowley.)

A. That is a code method. Most companies have modified [592] it a little in the way they use it.

Q. If I said to you without further explanation that a certain filter panel tested 90 per cent efficiency or 98 per cent efficiency, would that statement alone mean anything to you?

A. No, I would have to know how it was tested and on what basis the efficiency was reported, what kind of dust was used, and some of the factors involved in the test procedure.

Q. What are some of the things that you would have to know?

A. I would want to know what kind of dust was used, what dust mixture was used, how that dust was fed into the apparatus. I would want to know what the efficiency was based on, whether it was based upon the weight method, how those weights were taken, and so forth. Also the air velocity through the filter.

Q. Can changes in those various conditions make a change of the order of a slight change or a great change in the result which you would obtain?

A. It might make a great change. By changing, for instance, the type of dust, it would make a very big change in the performance factor of the filter.

Q. Would you explain a word which has been in question here, namely, "arrestance"? [593]

A. The arrestance is a common term used with air filter people to give the efficiency of the filter in terms of the dust taken out of the air. They used

(Testimony of Frank B. Rowley.)

that in the code originally in 1933 to differentiate from such efficiencies as resistance, and so forth. There are several factors and the arrestance is the one that applies to the dust taken out of the air.

The Court: The arrest of what? Arrest of dust?

The Witness: The arrest of dust.

The Court: It stops the dust?

The Witness: That is right.

The Court: Well, then, that has to be explained in terms of pounds or ounces or grams per cubic foot.

The Witness: Of air, that is right. They usually take it in whatever weight units that they are working on. If they are working in grams they say arrestance in grams.

The Court: Grams of what?

The Witness: It is a percentage.

The Court: Of cubic foot or a thousand cubic foot?

The Witness: It is grams or it is percentage of the amount of dust which is taken out.

For instance, if you fed 100 grams into the filter and there remained 70 grams in the filter, that would be an arrestance of 70 per cent, the percentage of air which is retained in the filter. [594]

The Court: The percentage of dust, you mean?

The Witness: Of dust. Pardon me.

Mr. Baldwin: Will you mark this?

(The document referred to was marked Defendants' Exhibit EE for identification.)

The Court: Regardless of the number of cubic feet of air?

(Testimony of Frank B. Rowley.)

The Witness: That is right.

The Court: Does not the rate of air flow through the filter have something to do with the efficiency or the value or effectiveness of it?

The Witness: Yes, that does, Your Honor.

The Court: In other words, it can flow 5,000 cubic feet of air through the filter in a minute and add 100 grams of dirt and you took out 70 per cent, that would be a different effectiveness than if you only flow 2,000 cubic feet through at the same time?

The Witness: That is correct, but still it would be an arrestance under those conditions that would be reported.

The Court: Well, then, when you give the arrestance you give the percentage and rate of flow of air?

The Witness: That should be incorporated with the whole test, all of the items.

The Court: In other words, the arrestance is 70 per cent at 2,000 cubic feet of air per minute? [595]

The Witness: That is right.

By Mr. Baldwin:

Q. I hand you a paper marked for identification Defendants' Exhibit EE and ask you to explain what it is, if you can.

A. This is a photograph of the test apparatus which we have at the University of Minnesota, showing the test set-up for testing and rating filters by the weight method.

This is set up in accordance with the code which

(Testimony of Frank B. Rowley.)
we spoke of—do you want me to explain it in detail?

Q. Would you explain just the chief parts of the apparatus in that photograph?

A. The chief parts of the apparatus are, first, a testing duct, a filter duct, which is shown in the center. That is a 20-inch square duct, which has been used fairly universally because there are so many 20-inch square filters made. It is a practical size to work with. And that duct holds the test filter in the center. It is sealed in the center of the duct.

At the left-hand side of the photograph is a duct feeding apparatus which has been designed to feed the dust into the air stream entering the filter. That is a method of mixing the dust with the air.

I might say that on the right just beyond the photograph and not shown there is a fan which draws the air from [596] the left to the right through the filter to be tested.

The Court: Is the filter here at the immediate entrance of this big tunnel or duct?

The Witness: No, it is right back of that board in the middle.

The Court: In back of the rack?

The Witness: In back of the rack. It is a little beyond the center.

The Court: Is this end open down here where the dust is?

The Witness: That is right. The air is drawn through the apparatus with a fan on the right and

(Testimony of Frank B. Rowley.)
the air then comes in at the left. There is an orifice that is cut about 12 inches in diameter there.

The Court: Is it open? It looks like it has a screen there.

The Witness: No, it is open, with the exception that the end plate—that end plate is a board—with a hole cut in there, that is open, and the air goes through that, and the dust then is fed into the center and mixed thoroughly with the air when it is pulled into the apparatus. And that air is pulled through the filter which is near the central section, and those gauges on the board are for the purpose of measuring the air pressure drop across the filter during the test. You have to know how much pressure drop is [597] required to pull the air through the filter.

Then on beyond the square duct where it comes into the round at the right, there is an orifice in there for measuring the volume of air which goes through the test apparatus. That is a standard rounded orifice and one of the gauges measures the pressure in order to get the volume of air flowing through the filter.

Then over at the extreme right of the photograph is a vacuum pump that is used for pulling the sample out of the air after it leaves the filter in order to find out how much dirt is left in the air after it passes through the filter.

I think those are the essentials of it.

By Mr. Baldwin:

Q. And how do you know how much dirt is fed into the filter?

(Testimony of Frank B. Rowley.)

A. That is determined by weighing the dirt on a disc. This dust feeding apparatus has a disc like a phonograph record disc and the dirt is weighed on that, the disc is weighed before the test and after the test, and the difference is the amount drawn in.

Mr. Baldwin: Will you mark this, please?

The Clerk: FF.

The document referred to was marked Defendants' Exhibit FF for identification.)

The Court: That is sucked off the phonograph record? [598]

The Witness: That is right. It is sucked off at a uniform rate. It is designed so that it gives a constant uniform rate throughout the test.

By Mr. Harris:

Q. I hand you a paper marked Defendants' Exhibit FF and ask you to identify it, if you can.

A. This is an enlarged or closeup view of the dust feeding apparatus that I just described.

Q. Is the dust on that round disc?

A. The dust is on the round disc at the left lower corner of the photograph and it is spread over that at a uniform thickness in area for the right amount of it and the disc rotates and a little ribbon is shaved off right under the pickup which is at the right side of the disc, and there it is picked up by suction and pulled into the test apparatus.

Q. Would you state how long you have used this apparatus?

(Testimony of Frank B. Rowley.)

A. Well, over 15 years, this particular one which we developed at Minnesota, probably 18 years.

Mr. Baldwin: Will you mark this?

The Clerk: GG.

(The document referred to was marked Defendants' Exhibit GG for identification.)

The Court: You have various kinds of dust that you test?

The Witness: There are different types of dust used and [599] the code specified 50 per cent carbon black and 50 per cent Pocahontas ash. Most manufacturers have reduced that now to 20 per cent carbon black and 80 per cent Pocahontas ash.

The Court: Do you ever test it by taking actual dust samples from the air?

The Witness: Not by the weight method. That has been a difficult problem to get enough dust out of the air for this type of a test so that you can get enough weight to form a test and keep it in the dust form.

That is one reason for getting the carbon and Pocahontas ash in the samples. A great deal of work was done at the beginning when this code was established and also since trying to get a dust, a mixture, which would simulate the dust that we have in the ordinary air, and it was felt that we had to have carbon in it but felt that 20 per cent probably represented more adequately the amount than 50 per cent.

(Testimony of Frank B. Rowley.)

By Mr. Baldwin:

Q. I hand you a paper marked for identification Defendants' Exhibit GG and ask you to explain, if you can, what it represents.

A. This represents the smaller test duct which was set up for the purpose of testing six-inch square filters or seven-inch outside square filters by the same test method as used on the one I have just described.

Now this was set up in such a way that the same fan [600] which was used on the big duct could be used to pull the air through the small test duct and the same dust feeding apparatus could be used and the filter was clamped in the six-inch square duct, and in this case the dust in the downstream air was taken out by what is known as an absolute filter. That is, it was filtered through a fine fiberglass material—I think they call it—I have forgotten the name, but anyhow it is a fine filter, and it takes the dust all out of the air, and that was used for sampling the downstream side of the air.

Q. Would you say that the fiberglass filter you just mentioned was similar to a wad of cotton as to fluffiness?

A. Yes. It is more dense. It is a very fine fiber, packed, and it is packed so closely that it filters out, as far as we can tell, a hundred per cent of the dust. And it is a filter that is used by several test laboratories for sampling the air as one method of getting a sample of the dust in the down stream side of the filter.

(Testimony of Frank B. Rowley.)

Q. I believe you have stated the dust you used was in the tests which you made for Air-Maze Corporation, was what you call 80-20, or 80 per cent Pocahontas fly ash and 20 per cent carbon black, is that correct?

A. It was 80 per cent Pocahontas ash, not fly ash but Pocahontas ash, screened through a 200 mesh screen and 20 per cent carbon black, and the particular brand was K-1 manufactured [601] by L. Martin Company, and that was screened through a 100 mesh.

The two of them were mixed and the mixture was again put through a 100 mesh screen for better mixing of the dust.

Q. About what was the density of this dust?

A. It was about .55 grams per cubic centimeter. That is the jolted density.

The Court: The what?

The Witness: The jolted density. We put dust in a container and it is fluffy, and we jolt it down.

The Court: Pack it down?

The Witness: Pack it down. We do it by jolting it.

By Mr. Baldwin:

Q. Have you been in the testing laboratories of any filter manufacturers who manufacture filter panels like the Far-Air filter and the Air-Maze P-5 filter? A. Yes.

Q. Which laboratories have you been in?

A. Well, I have been in Air-Maze laboratory, of course. I have been in the Burgess laboratory.

(Testimony of Frank P. Rowley.)
That is the Research Products Laboratory now. I have been in the Owens-Corning Laboratory and the Bureau of Standards laboratory. [602]

By Mr. Baldwin:

Q. Any in Kentucky?

A. No, I don't think so. No, I haven't been in anything in Kentucky.

The Court: "In anything"?

The Witness: Any air filters.

Mr. Leonard S. Lyon: If Your Honor please, the witness has not included the Farr Company, and if he would like to see the Farr Company equipment, so that he could be informed as to that, in connection with his testimony, Mr. Duncan would be very glad to take him down there during the noon recess and show it to him, if that would help him any. [603]

* * * * *

Mr. Leonard S. Lyon: I don't propose to go. I just suggest that Mr. Duncan take him out and answer any questions the witness wants to know about the equipment.

By Mr. Baldwin:

Q. Will you state what dusts were used in these laboratories you visited?

The Court: Or have you already seen the Farr patented device?

The Witness: No. I think I heard something about it but I never saw it.

The Court: Do you want to go and see it?

The Witness: If it doesn't interfere with things, I would like to, sometime. I might say I am not

(Testimony of Frank P. Rowley.)

aiming at criticizing their equipment. I am presenting these things, I am just telling you what I have seen. [605]

The Court: You had asked him whether or not he had ever been in Kentucky, is that correct?

The Witness: I think that referred to the American filter. I have never been in their laboratory. I have talked to their men, but I have not been in their laboratory.

The Court: Have you ever been in their laboratory?

The Witness: No.

The Court: I suppose in Kentucky there are a great many installations in the tobacco plants.

The Witness: I presume so.

The Court: And in horse barns, maybe?

The Witness: I know they have the horses.

By Mr. Baldwin:

Q. The question was, what test dusts were used in these laboratories which you have visited?

A. Well, they have varied somewhat. The predominant test dust has been a mixture of 80 per cent Pocahontas ash and 20 per cent——

The Court: Well, what is the difference between this Pocahontas ash and Pocahontas fly ash?

The Witness: The difference is in the way it is prepared. Pocahontas ash is left over after a slow burning of the coal, and the fly ash, as generally understood, is the ash, small particles that are picked up at the back of a furnace, at a power furnace, from the fire, ash that pulls up [606] the stack and goes outside.

(Testimony of Frank P. Rowley.)

The Court: In other words, it is a lighter weight ash?

The Witness: No, it is not really a light weight. It is more of a granular ash, but it flies up due to the draft in the stack.

The Court: That is where the term "fly ash" comes from?

The Witness: That is where the term comes from.

By Mr. Baldwin:

Q. Which of these companies, whose laboratories you visited, use the 80-20 dust you have mentioned?

A. Well, the Madison laboratory, which is Research Products now, and it used to be the Burgess; the Owens-Corning use it, and we use it, of course.

The Court: You use it?

The Witness: We use the 80-20.

By Mr. Baldwin:

Q. What does Air-Maze use, if you know?

A. They use 80-20. The Bureau of Standards uses fly ash and lint. They use the lint in the dust, in place of the carbon, that is, their mixture is a little different.

The Court: The carbon is coal dust?

The Witness: It is stuff that floats around in the air. No, it isn't the coal dust. It is the stuff that corresponds to the soot. It comes out of the stack. [607]

* * * * *

Q. Professor Rowley, the last question I asked you had to do with the composition of the National

(Testimony of Frank P. Rowley.)

Bureau of Standards dust. Would you please state that again, if you will?

A. I think I said fly ash. It is actually Cottrell ash that they use.

The Court: You said Pocahontas ash.

The Witness: Not the Bureau of Standards. They use Cottrell ash.

By Mr. Baldwin:

Q. What percentage? A. 96 per cent.

Q. What is the rest? A. Lint.

The Court: What is the difference between Cottrell ash and Pocahontas ash? [609]

The Witness: The Cottrell is a little heavier and it is a fly ash, whereas Pocahontas is a burnt ash.

The Court: Cottrell ash is entirely a fly ash?

The Witness: It is precipitated out. It is probably a little finer than the average fly ash. It is precipitated out.

The Court: And the ordinary term of fly ash is soot?

The Witness: Well, I would say that soot is in it but I think fly ash is a little heavier than soot. It is the fine ash that goes up the chimney but more of a dust, more of a granular dust.

The Court: Very well.

By Mr. Baldwin:

Q. It has been stated in this action that the Farr Company tests its filter panels with a special kind of Arizona road dust. Do you know of any filter manufacturer known to you who is now testing filter panels with Arizona road dust?

A. No, not of this type of panel that we are talking about.

(Testimony of Frank P. Rowley.)

Mr. Leonard S. Lyon: I can't hear the witness.

The Witness: No.

By Mr. Baldwin:

Q. I show you Plaintiff's Exhibit 12, which is labeled Air-Maze filter P-5, and ask you if you tested a panel of [610] that type.

A. Yes, I did.

Q. As near as you know, it was exactly like this? A. Yes, it was.

The Court: That is the P-5?

Mr. Baldwin: P-5; yes, Your Honor.

The Court: The alleged infringing device, is that correct?

Mr. Baldwin: That is correct.

Will you mark this, please?

The Clerk: HH.

(The document referred to was marked Defendants' Exhibit HH for identification.)

By Mr. Baldwin:

Q. I hand you a chart marked for identification Defendants' Exhibit HH and ask if you can identify it. A. Yes.

Q. Will you state what it is?

A. It is a graphical presentation of the results of my test on the P-5 Air-Maze filter just identified. I don't know the number.

The Court: Exhibit 12.

The Witness: Exhibit 12.

By Mr. Harris:

Q. What does the upper curve on this chart represent? [611]

(Testimony of Frank P. Rowley.)

A. The upper curve represents the arrestance or, in other words, the efficiency in terms of the percentage of dust retained on the filter throughout the test.

Q. Will you read a few values so as to illustrate the trend of that curve?

A. The trend of the curve, it starts out at the left about 77.6 per cent efficiency, and it goes to the right to about 18 hours—that is on the horizontal scale—at substantially the same efficiency, where it begins to drop.

The Court: Eighteen hours?

The Witness: That, Your Honor, is on the bottom scale.

The Court: Time in hours?

The Witness: Time in hours. There are three items on that bottom scale that I might explain.

The Court: I see. Those are the hours, and the one below is the dust load on the filter?

The Witness: That is correct.

The Court: Up to 18 hours?

The Witness: And then from there on it begins to drop, and at 22 hours the efficiency is around 76 and two or three tenths per cent.

The Court: What are those dots on there?

The Witness: Those are dots of the actual values of my test per each hour. The tests are run in hourly intervals. Each hour we take a check to get the calculated efficiency [612] from the dust caught by the filter and the dust fed in and those are actually the test points.

(Testimony of Frank P. Rowley.)

Now those test points very seldom fall on a good curve. They are points and are subject to the conditions of the test, variations, so we plot those on the graph and then we draw the curve through, which is our interpretation of the test results, a smooth curve.

The Court: How would you account, for instance, for this at 16 hours the dust arrestance or efficiency jumping from 77 up to 80?

The Witness: I believe that is at the time the test was stopped overnight.

Now we run these tests, Your Honor, part one day and part the next, and usually when we stop a test at night and start it the next morning the efficiency is a little higher the next morning due to the fact that the dust has had a time to soak through the oil and it collects a little better for a few hours.

Mr. Leonard S. Lyon: The witness says he believes that he can tell us whether or not that is so. I would like to know.

The Witness: Yes, I have tested many of them.

* * * * * [613]

The Witness: I should, I think, explain the other figures on this horizontal line.

The Court: Yes.

The Witness: On the central line there, of course, are the hours of the test, and the figures on the top of that line give the weight of dust fed in grams into the filter, which accumulated for the period, so any figure along there represents the

(Testimony of Frank P. Rowley.)

total dust in grams that was fed to the filter at that time.

And the lower line represents the total dust that was retained by the filter at that period.

The Court: And that is how you get your percentage curve?

The Witness: That is correct.

The Court: At the top, is that correct?

The Witness: That is correct.

The Court: And the lower curve here on the graph is the filter resistance?

The Witness: In inches of water throughout the test.

The Court: In the test described by the first witness here.

By Mr. Baldwin:

Q. Will you explain where that resistance curve starts and stops?

A. The resistance curve in this case starts at .05 inches of water and it ends at .17 inches of water at the [615] end of the test, which was 22 hours.

The Court: That is called your pressure drop also?

The Witness: Yes, that is right.

By Mr. Baldwin:

Q. I notice, in line with the explanation you gave to the Court this morning, that you have neglected to mark on this curve the air velocity. Will you state what that was?

A. The air velocity is 300 feet per minute, face velocity of the filter.

(Testimony of Frank P. Rowley.)

The Court: 300 feet per minute?

The Witness: 300 feet per minute. That is correct.

The Court: Did you ever test it at 519 feet per minute?

The Witness: Not this filter, no.

The Court: Not that filter.

By Mr. Baldwin:

Q. I hand you Defendants' Exhibit A and ask you if you have tested a filter having the filter media like that. A. Yes.

Q. What size was the filter you tested?

A. A 20-inch-square filter.

Mr. Baldwin: This is the P-5 obsolete, Your Honor.

The Court: All right.

The Witness: I might say, when I say "a 20-inch square," these filters are just a little less than that. I tested a commercial size, 20-inch size. [616]

The Court: Why did you introduce the air at 300 feet per minute?

The Witness: Well, that is the air velocity that is normally used in testing, and there was no particular reason that I knew of for testing it at 519.

The Court: Well, is the velocity of air that is ordinarily fed into an air-conditioning unit or through a filter——

The Witness: Yes.

The Court: ——at 300 feet per unit or at 519?

The Witness: Well, ranging between there, 300 and up to 500.

The Court: Up to 500?

(Testimony of Frank P. Rowley.)

The Witness: Yes. There isn't any specific velocity, to say that is the velocity that is used on all of them.

The Court: I suppose on some installations there is a great deal faster rate?

The Witness: Yes, there are some faster.

The Court: On motors?

The Witness: On motors: When it comes to carburetors and Diesel engines, that is very much higher. That is a different type of filter usually used, too.

Mr. Baldwin: Will you mark this, please?

(The document referred to was marked Defendants' Exhibit II for identification.)

By Mr. Baldwin: [617]

Q. I hand you a paper marked for identification Defendants' Exhibit II and ask you if you can identify it.

A. Yes, That is the curve representing the test results which I obtained on the 20-inch-square Air-Maze P-5 obsolete type of filter, Exhibit A. The test was made by the same methods, the same air velocity, the same conditions, as the one just described.

Q. The one just described is—— A. P-5.

Q. ——P-5, and is Exhibit HH?

A. Exhibit HH.

Q. Would you state a few representative facts that you obtained from this Exhibit II, as to arrestance?

(Testimony of Frank P. Rowley.)

A. As to the arrestance, the arrestance started a little higher than average. It started up at a little above 84 per cent and it dropped down until it struck about 80 per cent, at 10 hours' period, and at 13 hours of testing it started to drop and dropped down until, at 19 hours, it had dropped down to 60 per cent arrestance.

Q. And would you read some representative values from the resistance curve?

A. The resistance curve starts at .05 inches of water and it ends up at .08, a little over .08 inches of water at the end of 19 hours.

Mr. Baldwin: Have you Exhibit 2, Mr. Clerk?

The Court: In other words, what this means is that at the end there of 13 hours, the capacity of the filter to retain the dust passing through it was reduced in percentage?

The Witness: That is correct.

The Court: Very rapidly?

The Witness: Dropping down, that is right.

By Mr. Baldwin:

Q. Do the results plotted on Defendants' Exhibit II indicate to you a good or a poor filter?

A. It indicates it is a good filter.

Q. Up to what dust load?

A. Up to the dust load of about five hundred and—well, the dust load on the filter would be about 425 to '50 grams.

This starts out at a very good efficiency and runs good efficiency until it gets out to about 13 or 14 hours.

(Testimony of Frank P. Rowley.)

Q. I show you Plaintiff's Exhibit No. 2 and ask you if you tested a filter like that. A. Yes.

The Court: Plaintiff's Exhibit 2 is what?

Mr. Baldwin: Exhibit 2 is the Farr panel——

The Court: In suit.

Mr. Baldwin: ——in suit, the '479 patent.

The Witness: Yes.

The Court: The air was fed at 300 feet per minute? [619]

The Witness: Yes, that is correct.

The Court: On all these tests that were conducted?

The Witness: All these tests, at the same air speed, the same conditions.

The Court: The same air speed, the same dust?

The Witness: And the same conditions.

The Court: And the same quantity?

The Witness: The same rate.

The Court: The same rate?

The Witness: That is right.

By Mr. Baldwin:

Q. I hand you another paper marked for identification Defendants' Exhibit JJ, and ask you if you can identify it. A. Yes.

(The document referred to was marked Defendants' Exhibit JJ for identification.)

Q. What does that represent?

A. That represents the test data which I took in testing the Farr filter in suit. I have forgotten that exhibit number.

The Court: Exhibit 2.

(Testimony of Frank P. Rowley.)

The Witness: Farr filter, Exhibit 2. And this was tested with the same dust, the same dust feed, and all conditions the same as the other two I have just described.

Mr. Baldwin: What was that last answer? [620]

(Record read by the reporter.)

By Mr. Baldwin:

Q. Now, will you explain the values, just roughly, from this curve, Exhibit JJ?

A. Well, taking the arrestance values, you will note at the top left-hand corner there is a very high value there, the filter starts, and at the end of the first hour gave a very high arrestance value. Then it dropped down to just about 80, a little above 80, and from there on its gradually dropped until at the end of 14 hours it was to 76, and at the end of 21 hours the arrestance was 75½, about. Now, that drop—I mean that high value at the start, I checked on a couple of other tests and they seemed to be characteristic, they seemed to get that high test with the immediate drop after the first hour.

The Court: Oh, it started way up here at 94?

The Witness: Way up there very high, when I first started it.

By Mr. Baldwin:

Q. On how many tests did you find that same characteristic?

A. I found it on two other tests, I checked it twice besides this and found the same general characteristic.

(Testimony of Frank P. Rowley.)

Q. A total of three tests? A. Yes. [621]

Q. Have you any theory as to why that happens?

A. Well, I think it happened perhaps because I may have had excess oil in that it hadn't been drained off between those contact points. There are a lot of contact lines where the flat screens contact the ridges of the corrugated ridges and they naturally retain the oil for some time after it is soaked and perhaps that was not drained off or blown off thoroughly before the test started. And that would give a high value to the first hour until that disappeared.

Q. Will you read a few characteristic values from the resistance curve?

A. The resistance curve starts at .05 inches and gradually rises so that at the end of 21 hours the resistance is .14.

Q. You have stated that you tested a 20x20 Air-Maze P-5 filter? A. Yes.

Q. What size was that?

A. I tested a 7-inch P-5, that is, 7 inches outside, 7 inches square.

Q. Will you explain 7 inches outside and what you mean by that?

A. I mean that was the dimensions of the filter frame.

The Court: Commonly referred to here as a 7-inch filter. It has area exposed that is reduced by the width of [622] the frame, whatever it is.

The Witness: That is right.

(Testimony of Frank P. Rowley.)

The Court: And that is called a 7-inch frame.

The Witness: That is a 7-inch frame, and my test values, run the area exposed, is a 6-inch filter.

Mr. Baldwin: I just wanted to bring out that it is a 6x6 area exposed.

The Court: Is this a 20x20 exposed?

The Witness: Your Honor, there is a difference when we test a large filter 20x20, so that this little area around the edge doesn't make much difference, but when we test a 7-inch filter it makes quite a difference, so to take care of that in this small filter we fill that area between there with a round half an inch of paraffine so we have actually a six-inch filter.

Mr. Baldwin: Will you mark this, please?

The Clerk: KK.

(The document referred to was marked Defendants' Exhibit KK for identification.)

The Court: That is the Air-Maze? There is one in evidence, is there, a 7x7?

Mr. Harris: No, I don't think so, your Honor.

By Mr. Baldwin:

Q. I will ask him: Was the filter media of this 7x7 panel exactly like the filter media of the 20x20 filter? [623]

A. Yes.

The Court: The P-5?

The Witness: The P-5.

(Testimony of Frank P. Rowley.)

By Mr. Baldwin:

Q. I hand you a paper marked for identification Defendants' Exhibit KK and ask if you can identify it?

A. Yes. The paper KK represents the curve or test values which I obtained from the 7-inch square filter on the test which I ran on the 6-inch square duct. These values are in arrestance and resistance just as the others were.

The Court: Is this the same rate?

The Witness: This is the same rate of dust fed.

The Court: And 20 grams?

The Witness: And 20 grams per hour reduced, because, you see, it is on the same ratio because this filter is smaller.

The Court: The ratio of 6x6 to 20x20?

The Witness: Yes, that is right.

By Mr. Baldwin:

Q. Will you explain two points upon the curve toward the left-hand side of the arrestance curve which seem to be way out of line?

A. Well, this was calibration. The primary purpose of running this test was to check the calibration of the 6-inch [624] duct which we had just built for these small filters, and in determining the efficiency we took the dust in the air on the downstream with an absolute filter, that is, I filtered all of it, and for the first two tests it was running high due to the fact that I wasn't catching all of the dust in that filter.

We got that corrected and it began to run uni-

(Testimony of Frank P. Rowley.)
formly, and since it was merely a check to check the apparatus, I considered when we had run those six or eight hours uniform that that was sufficient so that those areas were taken care of.

Q. I hand you Defendants' Exhibit GG and ask you to point out where this absolute filter media was in this test set-up.

A. The absolute filter media in this test set-up is at the expanded area just below the gauge board on Exhibit GG.

Q. What did you testify that filter media was at that point?

A. It was Corning fiberglass, very fine. It has a special trade name but I cannot think of it now. But it is a fine fiberglass. It is almost a perfect filter. It takes out a hundred per cent of the dust.

Q. And had you made a preliminary check to see whether it would catch a hundred per cent of the dust?

A. Yes. I made that check by taking the filter out [625] and feeding a given amount of dust into the duct and taking then the amount of that dust collected on this absolute filter media and that checked.

Q. In other words, you checked that amount on the absolute filter with the amount that came off of that feeding disc, is that correct?

A. Yes, that is correct.

Q. And how did this other filter media get in this for two hours?

A. Well, that was in this case—it was the be-

(Testimony of Frank P. Rowley.)

ginning of the test and that filter media was the same, but it wasn't clamped in tight enough to catch all of the dust, and you see, with a continuous test, we wouldn't know that until after we had run the first test and calculated it and by that time we were well into the second test so we couldn't correct it until after the second hour. [626]

Q. As a result of this arrestance curve on this 7x7 air panel, the Air-Maze P-5 filter, how does it check with the data on Exhibit HH?

A. Well, it gives a little lower resistance. It checks rather well though.

Let me see Exhibit HH.

(The document referred to was passed to the witness.)

The Witness: Yes, that is right, it gives a little lower arrestance value. That may be due to the filter or something but at any rate it shows it is running very uniform.

By Mr. Baldwin:

Q. What does this indicate to you as a matter of calibration of the 6-inch duct with the 20x20 duct?

A. It checks with it. It is satisfactory.

The Court: Do you know whether or not there are commercial installations made of the 7-inch filter?

The Witness: Well, I think there are, yes. There are different sized filters. I know there are some filters that are very small for special purposes.

(Testimony of Frank P. Rowley.)

Mr. Baldwin: Your Honor, this is a dirty job. I don't know whether the clerk can mark this or not.

The Clerk: LL.

(The article referred to was marked Defendants' Exhibit LL for identification.) [627]

By Mr. Baldwin:

Q. I hand you an article marked for identification Defendants' Exhibit LL and ask if you can state what it is.

A. This Exhibit LL——

Q. Pardon me. I withdraw the question for the moment.

Have you read and do you understand the translation of the French patent, No. 739,935 granted to Niestle, Defendants' Exhibit B, tab 15.

A. Yes.

Q. Will you identify, if you can, Defendants' Exhibit LL for identification?

A. Defendants' Exhibit LL is a small size filter, a 7x7, which was constructed after the teachings of the French patent to Niestle.

Q. Will you explain the circumstances under which this Exhibit LL was constructed?

A. I went to the Air-Maze factory, I studied the patent thoroughly and I discussed the construction with the research staff and the engineer at the Air-Maze Company, together with myself, and decided upon the type of construction which I was satisfied was representative of the teachings of the

(Testimony of Frank P. Rowley.)

French patent. And then this filter was constructed according to those instructions and this model was sent to me for test.

Q. Did you examine Exhibit LL thoroughly before you [628] tested it? A. Yes.

Q. I hand you Defendants' Exhibit CC and ask the relationship between Exhibit CC and Defendants' Exhibit LL.

A. Exhibit CC is one of the screens of which Exhibit II is constructed. Exhibit LL was constructed by using these screens, this mesh cut as these are, and packed together in the filter in such manner that the openings through this screen, which are the diamond-shaped openings, would pass the air from front to back of the filter.

The Court: The flow of the air was along the plane of it?

The Witness: At an angle.

The Court: At right angles?

The Witness: Not right angles, your Honor.

The Court: Well, to the plane——

The Witness: Right angles to the original screen but it was at an angle to the screens which went to make up the passages.

The Court: In other words, the flow of the air was as you have now indicated by your pencil?

The Witness: That is right.

The Court: It was introduced that way?

The Witness: That is right.

The Court: And not along the screen? [629]

The Witness: Not along the screen. It was in-

(Testimony of Frank P. Rowley.)
troduced along here which was at an angle to the actual screen members of this panel.

The Court: Very well.

By Mr. Baldwin:

Q. I call your attention to a clear window on one side of the Exhibit LL and ask if you will state the nature of what you see in that window.

A. The window shows the edge view of those screens, that is, the top view, and shows the paths through the filter which are formed by the screen members.

The Court: What is that, an asbestos bottom?

The Witness: It is just an insulation to keep the dust away.

The Court: And they were welded together?

The Witness: They were put there in spot weld.

The Court: Spot welded?

The Witness: Yes, sir.

The Court: Which was the front of this and which was the back, do you know?

The Witness: This side.

By Mr. Baldwin:

Q. By "this" side you mean?

A. This is the dirty side, the side that has the black. That was the entering side. [630]

Q. Would you compare the condition of the entering and leaving side?

A. The entering side is very heavily covered with black dust and the leaving side has black dust through the screen, but the leaving side of the

(Testimony of Frank P. Rowley.)

screen does not have the black dust on it. It is the entering side that has the heavy dust. [631]

The Court: What was that, now?

The Witness: The heavy dust is on the entering side of the screen.

The Court: Oh, I see.

The Witness: And the leaving side does not show the heavy dust that the entering side shows.

The Court: And what was that, Pocahontas ash and what is the other stuff?

The Witness: And carbon black. It is the same dust we used in the others.

By Mr. Baldwin:

Q. And what was the mesh of the woven wire material of Exhibit LL?

A. It is 30-mesh screen.

Q. And what is the mesh of the woven wire material of Exhibit CC?

A. That is 30-mesh also.

Q. I hand you Defendants' Exhibit DD and ask you to compare that construction with Exhibit LL.

A. The principle of the construction of Exhibit DD is the same as the construction of LL. The screen used in this (indicating) is of a coarser mesh than it is for LL, that is, coarser in DD than in LL, and the openings which pass through the filter are wider and a little larger in area for the Exhibit DD than they are for LL. Otherwise, it is the same or very [632] similar, it is the same type.

Q. I call your attention to the top window of

(Testimony of Frank P. Rowley.)

Exhibit DD and ask the general shape of whatever you see in there, what do you see there?

A. Well, I see the edge view of the air passages through the filter.

Q. And what is their general shape?

A. And the general shape of the air passages is a Z-shape as it goes from the front to the back of the filter.

Q. I call your attention to a similar window on Exhibit LL and ask you to compare the construction.

A. The construction is the same. Those in Exhibit LL are Z-shaped, just as they are in Exhibit DD.

Q. Do you mean the same or similar?

A. Similar.

Q. Did you test Exhibit LL?

A. Yes.

Q. Under what conditions?

A. I tested Exhibit LL in the small, seven by seven or six-by-six-inch square test area which I have described, and I tested those under exactly the same conditions as the other filters were tested, I used the same size velocity to the filter, the same dust feed, the same rate per square foot of area, the same relative rate, and used the same test procedure as for the other filters. [633]

The Court: That is, seven by seven?

The Witness: It is actually six by six, inside.

The Court: Six by six inside?

The Witness: That is right.

(Testimony of Frank P. Rowley.)

The Court: You did not fill the outside of that with paraffin?

The Witness: We did in here, yes, around in here. We did on this window but we did not on the sides.

By Mr. Baldwin:

Q. were the conditions under which you tested that Exhibit II identical with the conditions of the tests and as plotted in Exhibit KK from the third hour on?

A. Yes. Well, there is one point I want to explain when we come to the data.

The Court: You have a separate chart there?

The Witness: Yes.

Mr. Baldwin: Yes.

Q. Did you or did you not coat Exhibit LL with oil before you tested it? A. Yes.

Q. With what oil?

A. With the same oil. All of these were coated with S.A.E. 40 oil.

Q. Is that a light or heavy oil?

A. It is medium heavy. [634]

Mr. Baldwin: I ask that this document be marked as Defendants' Exhibit MM for identification.

The Court: Exhibit MM, test chart.

The Clerk: MM.

(The document referred to was marked Defendants' Exhibit MM for identification.)

(Testimony of Frank P. Rowley.)

By Mr. Baldwin:

Q. I hand you a paper marked for identification Defendants' Exhibit MM and ask you if you can identify it.

A. Yes.

Q. What does that show?

A. This shows the result of the test which I made on filter marked Exhibit LL, and the conditions of the tests on the units shown on this diagram, the same as on the others.

The Court: And were the conditions all the same?

The Witness: All the conditions were the same.

The Court: The rate of flow of air?

The Witness: That is right, rate of flow.

The Court: And the percentage of grams?

The Witness: And grams.

The Court: And so on, and so forth?

The Witness: That is right.

By Mr. Baldwin:

Q. Would you read some representative data from the arrestance curve of Exhibit MM? [635]

A. The arrestance curve starts at 75 per cent and gradually rises until it reaches about 81.6, at 9 hours. From there it tapers slightly down. At the end of 14 hours it has reached slightly under 81 per cent arrestance.

Q. Would you read some representative figures from the resistance curve?

A. The resistance curve starts at .1 inches and rises until at the end of the test or at the end of 14 hours it has reached .44 inches.

(Testimony of Frank P. Rowley.)

Q. Would you explain the dirty condition of Exhibit LL?

A. This is the condition of the filter after it was taken out of the test, that is, it was taken out of the test, then I packed it, as it came in here, and sent it parcel post to Los Angeles, and this is the condition it arrived in, or substantially the condition, excepting for what dust was shaken off during shipping.

The Court: How do you get this percentage? You weigh the filter first, and then weigh it afterwards?

The Witness: Well, we could do that, but we get the percentage——

The Court: Oh, by that pressure drop, by that water "business"?

The Witness: No. We get the pressure of the filter resistance in inches of water.

The Court: Yes. [636]

The Witness: But, now, we get the weights of the dust going into the filter, by actually weighing the dust which goes in, and then we filter the air which leaves the filter and take the absolute increase in weight in that filtered material, to get the amount of dust which is in the air after it leaves the filter.

Mr. Baldwin: All right.

Q. So that, to recapitulate, if I might, for just a moment, you deduct what is downstream from what you fed in upstream?

A. That is right, and that is the amount left in the filter.

(Testimony of Frank P. Rowley.)

Q. Is this Defendants' Exhibit LL the only filter constructed according to the French patent submitted to you by Air-Maze Corporation?

A. Yes.

Q. Does the data plotted on Exhibit MM indicate to you a good or a bad filter?

A. This indicates a good filter.

Q. Does the fact that the resistance rose at the end of 14 hours to .44 inches of water indicate that this filter should be classified as an unsatisfactory filter? A. No.

The Court: What does it indicate?

The Witness: Well, it indicates the pressure rise. [637]

The Court: Well, but I mean insofar as its utility is concerned.

The Witness: Well, it indicates that it is a practical filter, because it has a rather high efficiency, but also we know that, as far as the filter is concerned, we could change the screen in here and put in a little bigger screen and we would have a little greater resistance. You see, we have a very fine screen there.

The Court: But with that very fine screen and with this high resistance, pressure drop, doesn't it mean you would have to take it off and clean it more often?

The Witness: You would have to take it off and clean it more often than one that would run twice that long, that is true, but you are taking a very great percentage of dust out of the air. The filter,

(Testimony of Frank P. Rowley.)
as to the value of it, it depends on the purpose. Now, if you are satisfied to take out 75 per cent and you have a longer-life filter, and if you want to take out 80, or something like that, per cent, the more dirt you take out, the faster it is going to fill up. Furthermore, the filter will have to be designed to take out dirt, and when you do that you are going to have a higher resistance filter. It is a different construction, a different type.

The Court: Then, when you want to take out a hundred per cent, you use the spun glass, is that right?

The Witness: That is one way of getting it out, but [638] that is a very high resistance and you have to change there.

The Court: Well, it starts out with a high resistance, doesn't it?

The Witness: Yes.

The Court: It would have to?

The Witness: It would have to, to take it out.

The Court: What was the resistance in that spun glass filter, where did you start out, in point of inches of water?

The Witness: For this velocity through the filter it would probably start out at six or eight inches or more than that. It was pretty high.

The Court: Did you test that on your spun glass filter?

The Witness: Not exactly on that basis. We expanded the area. But if you tried to carry the air through that filter at this 300 feet, it would have a

(Testimony of Frank P. Rowley.)
very high pressure drop. It would be impractical for any air-conditioning system, to use that kind of a filter.

The Court: Because of the high pressure drop?

The Witness: Because of the high pressure drop and then because of the cost and everything else.

The Court: You mean the cost of the original installation or the cost of forcing the air through them?

The Witness: Both.

The Court: Both?

The Witness: Yes. [639]

The Court: You would have to put fans or suction pumps or something in it to get air in it?

The Witness: You would, or else you would have to have a very large area of the filter if you were going to force the air through with anything like 300 or 500, you would have to have very large fans.

The Court: Very large fans?

The Witness: High-pressure fans.

The Court: Which would be expensive to install and maintain?

The Witness: Yes, that is right.

The Court: Well, that would be true of any filter which would operate 100 per cent, wouldn't it?

The Witness: Well, it would be one of these types we are speaking of. There is an electrostatic filter which is very efficient, and of course that can be designed at low resistance. That is a different type of filter.

(Testimony of Frank P. Rowley.)

The Court: I see. And has the additional disadvantage in maintenance of using electricity?

The Witness: Yes.

The Court: The cost of electricity?

The Witness: Yes.

By Mr. Baldwin:

Q. Have you had experience with filtering ordinary dirty air under city conditions? [640]

A. Yes.

Q. Under average city dust conditions, about how long will it take that filter, Defendants' Exhibit LL, to collect the amount of dust it collected in your 14-hour test?

A. Of course, city conditions vary so much, it is difficult to give an absolute answer to that, because it would depend on where the dust is taken in the city and how high a level, and various things, but I would say from 30 days to 40 days, maybe, depending on the conditions.

The Court: Well, it depends on the city, first?

The Witness: The city, that is correct, where it is.

The Court: Where it is in the city?

The Witness: Where it is in the city, and the elevation make a lot of difference.

The Court: That is the elevation above ground?

The Witness: Yes.

The Court: Or elevation above sea level?

The Witness: Above the ground. If you are close to the ground, you have a lot of heavy dust that you do not get when you get up at higher levels.

(Testimony of Frank P. Rowley.)

By Mr. Baldwin:

Q. Do you know when this filter panel, Defendants' Exhibit LL, in practical use would have to be cleaned, about how often?

A. At least once a month, I would say. [641]

* * * * *

Q. Professor Rowley, are there any figures on dust conditions in cities in the United States?

A. Yes, there are. There have been many surveys made, and the conditions are variable. They run in wide ranges of dust.

Q. What is the range of a city?

A. It is probably about one-tenth of a grain per thousand, one-tenth of a grain per thousand cubic feet, up [642] to two.

The Court: Two grains?

The Witness: Two grains, perhaps. I would have to check that up. I can't give you those exact figures.

By Mr. Baldwin:

Q. So that when you answered my question a moment ago under average city conditions, what was the basis of your answer?

A. It was on the basis of the average dust which I would expect in a city, in the average city.

Q. Based on your studies? A. Yes.

The Court: Well, in the average city, I suppose every city has a sand pit or a cement plant. Would it be the average dust around the home or residence?

The Witness: Yes, around the city home, yes.

(Testimony of Frank P. Rowley.)

The Court: Around city homes?

The Witness: Yes.

By Mr. Baldwin:

* * * * * [643]

Q. You have stated that you coated the media, the filter media, of Exhibit LL with S.A.E. 40 oil before you tested it? A. Yes.

Q. Would that S.A.E. 40 oil fill the interstices of this woven wire material? A. Yes, it will.

The Court: Solid?

The Witness: It will fill them solid. It depends on the temperature as to how long it stays in there, the temperature of the oil and the position of the screen.

The Court: By the way, were all these tests conducted under the same temperatures?

The Witness: Yes.

The Court: What temperature was that?

The Witness: About 75 or 78. It is a laboratory temperature that we maintain at about 75 degrees.

The Court: Does the air increase in temperature?

The Witness: No, it is a large laboratory room.

The Court: I mean when you introduced it to this combined [645] duct, does the temperature increase?

A. No, there is no change. There isn't enough of a change.

The Court: It is not enough of a speed to increase the temperatures?

The Witness: No. You wouldn't get any change.

(Testimony of Frank P. Rowley.)

By Mr. Baldwin:

Q. How did you put the oil on Exhibit LL before you tested it?

A. I soaked the filter in a pan of the oil, both sides, so we submerged it completely in the oil. Then after it had been submerged and completely covered with oil we drained the oil off by hanging the filter up on one corner and drained the oil for 24 hours before the test.

Q. Did you know whether or not the oil drained out of the interstices of the filter media in 24 hours?

A. It would partly, yes. It depends on the position.

The Court: Did it?

The Witness: Yes, it did drain out, I would say. In the filter I couldn't tell but it would drain out.

The Court: From what you could see it had drained out?

The Witness: Yes, it had drained out.

By Mr. Baldwin:

Q. You have stated that you have had experience as a consulting engineer. Has any of that consulting work been in [646] connection with filter panels similar to the Far-Air filter or the P-5 filter involved in this action?

A. Yes, with these types of filters.

Q. Has it been with impingement type filters?

A. Yes.

Q. To what extent have you consulted in that manner?

(Testimony of Frank P. Rowley.)

A. Well, I have done a considerable work along programs. Last year, for instance, I was on one that took me for a whole year with the Orange-Cornung, and I have been on programs of that type. I can't say just how many hours, how many days or years that I spent on a good many problems.

What is the nature of the problems which are brought to you by these consultants?

A. Well, some of them are testing their filters that they have, consulting with them as to what changes might be made after we find out what the conditions are, changes in dust, changes in the method of oiling or greasing, like putting adhesive on the filter to get either longer life or to change the resistance by changing the fiber construction of the filters, and so forth. It is variable depending on what their problems are.

Q. Are you or are you not able to help them arrive at the filter characteristics which they desire?

A. I think so. Yes.

Q. If a filter manufacturer brought you Defendants' [647] Exhibit LL and asked you what he should do to it in order to lower its resistance, would you be able to advise him from your experience? A. Yes, I would.

Q. What would be the direction of the change which you might suggest to him?

A. Well, I would suggest changing the screen, opening up the mesh and also probably changing the size of the passages through the filter, making

(Testimony of Frank P. Rowley.)

changes which would affect the resistance of the air flowing through it.

The Court: In other words, you would simply reduce the mass of the media?

The Witness: Yes, and the arrangement of it probably.

By Mr. Baldwin:

Q. Have you read the file wrapper of the patent in suit? A. Yes.

Q. I quote you from page 21 of the file wrapper where this statement is made, speaking of the filter shown in the Manning patent, No. 2,079,297.

I show you Defendants' Exhibit B-9, which is the Manning patent, No. 2,079,297. I quote from the file wrapper:

"The result is that a——"

The Court: The file wrapper? Is that in evidence?

Mr. Baldwin: Page 21. Yes, your Honor. It is Exhibit [648] 1-A.

The Court: That is the file wrapper of the patent in suit?

Mr. Baldwin: That is the file wrapper of the patent in suit.

The Court: Not of the Manning patent?

The Witness: No.

The Court: I beg your pardon. I thought you were reading from the file wrapper in the Manning patent.

Mr. Baldwin: It is a comment about the Manning patent, your Honor.

(Testimony of Frank P. Rowley.)

The Court: I see. Page what?

The Witness: Page 21.

The Court: Yes?

The Witness: About the middle of the page, the last sentence of the paragraph, the last sentence of the first paragraph on the page, beginning:

"The result is that a substantial portion of the dust is carried through the filter by large streams of air which are not effectively impinged against the surface of the filter and accordingly the paper is not effective in removing dust from air."

Q. Have you had any experience with filters constructed according to the Manning patent? [649]

A. Yes.

Q. I hand you Defendants' Exhibit C and ask if that resembles a filter which you have tested.

A. Yes.

Q. Is it exactly like one you have tested?

A. I would not say exactly like it. I think the cells in this filter are a little larger than the one I tested. The same design.

The Court: We will have the afternoon recess.

(Short recess.)

By Mr. Baldwin:

Q. I believe you stated that you had tested a filter like Defendants' Exhibit C except that the corrugations were somewhat smaller, is that correct?

A. That is correct; the same type.

Q. Would you state when you tested such a filter?

A. I tested them in 1937, I tested several of

(Testimony of Frank P. Rowley.)
them, and just prior to that I tested them and since then.

Q. What work were you doing in 1937 with this filter?

A. In 1937 the Association of American Railroads decided to have a series of tests made to determine the efficiency or effectiveness of the various filters that were then used in railroad work. They came to Minnesota and asked me to take up that program, take charge of it, so I ran during that summer a long series of tests in which I used about 14 [650] different types of filters in testing to determine their arrestance, resistance, and so forth.

Q. Do you have the Manning patent in front of you? A. Yes.

Q. There is shown, is there not, a layer of expanded metal part way through the filter media of that patent, is that correct?

A. That is correct, in Fig. 2.

Q. Did the filter which you tested in 1937 have such a layer of expanded metal? A. No.

Q. Will you turn to the Kaiser patent, which I believe you have in front of you as Defendants' Exhibit B, tab 8. Is there shown there any construction which is more nearly like the filter which you tested in 1937? A. Yes, there is.

Q. Which figure would that be?

A. It is more nearly like Fig. 7. There was a little break as shown in Fig. 5.

The Court: That is the American air filter?

Mr. Baldwin: No, that is the Detroit air filter, your Honor.

(Testimony of Frank P. Rowley.)

Q. What was this filter known as at the time you tested it in 1937?

A. It was called the Arco, American Radiator Company, [651] at that time.

Mr. Baldwin: I call the court's attention to the fact that the Manning patent is assigned on its face to the American Radiator Company.

Q. When you say it resembled Fig. 7 of the Kaiser patent, what does that mean regarding the corrugations on the two faces of the panel?

A. The corrugations where they meet in the center make an abrupt angle with each other. The corrugations on the leaving side are a little smaller than they are on the entering side of the filter.

Q. Do you recall how this filter, similar to Defendants' Exhibit C which you have stated was then known as the Arco filter, do you recall how it tested in your tests of 1937?

A. Yes. It tested about 75 per cent or thereabouts.

Q. Seventy-five per cent what?

A. Arrestance.

Q. And do you remember anything about its resistance?

A. I believe it started about two tenths of an inch resistance.

Q. What do you remember of its dust holding capacity?

A. It held, I believe, around between five and six hundred grams.

Q. How did the conditions of this test of the Arco [652] filter in 1937 compare with the tests

(Testimony of Frank P. Rowley.)
which you have reported on here relating to Defendants' Exhibits HH, II, JJ, KK and MM?

A. Well, the tests procedure was the same. The dust used in those filter tests was a little different. We used there 50 per cent Pocahontas ash, same type, and 20 per cent carbon black, and 20 per cent Cottrell ash and 10 per cent Fuller's earth, so the dust mixture was a little different.

Q. Were those differences in dust of a nature to affect—in what degree would those differences of dust affect the comparative results of the Arco filter in 1937 and the Air-Maze tests in 1951?

A. I believe the test they used in 1937 would give a little higher rise in pressure and a little lower arrestance than the type of dust that I use now.

Q. I read to you from the file wrapper of the patent in suit, Exhibit 1-A, the following passage——

Mr. Leonard S. Lyon: What page?

Mr. Baldwin: This is page 73 of the file wrapper, the last sentence of the paragraph which ends in the middle of the page, which comments on the patents to Kaiser and Manning as will be seen by reference to the preceding portion of the same paragraph.

"Because of the straightening action of the walls of the passage on the direction of airflow, [653] it is easily demonstrated that there is little collection of dust in such filters beyond the entrance to the passages."

(Testimony of Frank P. Rowley.)

Q. Did you examine the passages of the Arco filter which you tested in 1937? A. Yes.

Q. Did you examine those passages in more than one filter of that same type? A. Yes.

Q. What did you find as to the distribution of the dust in those passages?

A. I found that it was distributed through the filter with more of it in the front of it but it was distributed through the filter.

Q. Did you find dust in all portions of the passages? A. Yes.

Q. Slight or medium or a lot or what?

A. Well, I found considerable dust all through it. It was fairly well distributed. It was a little heavier at the entrance and also at the break at the center. But it was all distributed through the passages.

Mr. Baldwin: This next exhibit, your Honor, I only have one copy of, but I have photostated three pages. I wonder if they may all have—perhaps the exhibit could have the first designation and the others then be clipped together with a [654] subscript or something of the sort.

The Court: What pages?

Mr. Baldwin: Pages 1, 8 and 9.

The Court: I will mark the exhibit NN and page 1 will be NN-1, page 8 will be NN-2 and page 9 will be NN-3.

(The documents referred to were marked Defendants' Exhibits Nos. NN, NN-1, NN-2 and NN-3 for identification.)

(Testimony of Frank P. Rowley.)

By Mr. Baldwin:

Q. I hand you a paper marked for identification, or a pamphlet marked for identification, Defendants' Exhibit NN, and ask you if you can identify it, that is, the complete pamphlet.

A. Yes. [655]

By Mr. Baldwin:

Q. What is it?

A. That is the report on the result of the research work which was done under my direction at the University of Minnesota, to determine some of the filter performance factors, and the paper is entitled "Air Filter Performance as Affected by Low Rate of Dust Feed, Various Types of Carbon, and Dust Particle Size and Density." And this paper was presented at the American Society of Heating and Ventilating Engineers' forty-fifth annual meeting, January, 1939, and it gives the results of some of our research program as I have stated.

Q. Do you remember how long this research took?

A. I can't state just exactly how long this particular research took. This is only a part of a considerable program that we were conducting. I would say that the work on here would take at least six months.

Q. Does the name "Frank B. Rowley" near the top of the page, which is underneath the title, refer to yourself? A. Yes.

Q. Would you state what the subject-matter was upon which you ran this paper, what were the articles which you did the research on?

(Testimony of Frank P. Rowley.)

A. They were different types of filters. We had four different types of air filters, and those filters are typical of certain designs and they are described, on page 1, as A, [656] B-1, C, and D, the first two being in the first column.

Q. I note that there is no identification as to the manufacturer of these various filters. Why is not the manufacturer shown?

A. It has been our policy in these researches not to give the manufacturers' names; merely to describe the object as something which would be constructed so it could be understood.

Q. Do you feel free, at this time, to identify these filters?

A. I think it would be all right. It is so late, now.

The Court: When was this published?

The Witness: In 1939.

The Court: When?

The Witness: In 1939.

By Mr. Baldwin:

Q. Will you state what those filters were, A, B-1, C, and D?

A. Well, A was an American filter.

B was an Owens-Corning.

And C was the Arco (American Radiator, as we called it at that time).

And D was a cloth filter of a different type.

Q. You state that B was an Owens-Corning filter. Would you give just a brief description of it?

A. Well, it was an Owens-Corning filter made

(Testimony of Frank P. Rowley.)

of viscous coated fiberglass, which is packed in a filter frame, known as throw-away type.

Q. Would you refer to page 9 of Exhibit NN, the photostat of which is designated NN-3, and explain table No. 7 at the top of that page?

A. Well, table No. 7 shows the relation between dust density and filter performance, and the dust feed stated there was 40 grams per hour, and the face air velocity was 300 feet per minute. And the note down below states that "All values based on a resistance rise of 0.15 inches of water across the filter." In other words, we take that rise, as what we assume the life of the filter, for the purpose of these tests, in order to get comparative values.

Q. That was something of an arbitrary limit?

A. That was an arbitrary limit, so we could get relative values.

Q. What is column 1?

A. Column 1 gives the different types of dust which we used in the tests, and those different types of dust which are enumerated there, and first we determined the density of that dust in grams per cubic centimeter, and that density in the second column, in grams per cubic centimeter, is what we term the jolted density, that is, there is a maximum density, we take the dust and jolt it down until we reach the [658] maximum density of the dust, and we get the grams per cubic centimeter.

The next column is merely the conversion to pounds per cubic foot.

Q. Would you state where the lightest and heaviest dust appears in these columns?

(Testimony of Frank P. Rowley.)

A. The lightest dust appears at the top and the heaviest at the bottom. They are arranged according to the densities.

Q. Explain the rest of the table.

A. The important part, then, is the last three-named groups there.

The first group says "Life in Hours." Under this heading is the life in hours of the four types of filters, A, B-1, C, and D, and those figures of life in hours represent the number of hours it took to raise the resistance to .15 inches in these tests, of water.

Next, I can explain those columns. The next four columns are headed, "Dust Holding Capacity in Grams," and those figures represent the amount of dust in grams that was held by each filter, with each type of dust, with the pressure rise of .15 inches.

And the last four columns are "Arrestance in Per Cent" for the four types of filters, with each of the dusts that are shown in column 1, and those arrestances are based on [659] the average arrestance during the time that the filter increased in resistance .15 inches of water.

Q. What were your general conclusions at the time of making this test, as to the effect of density upon the data of filter performance?

A. Well, the density has a very great effect on all of those three items, the life in hours, the dust-holding capacity in grams, and the arrestance in per cent. However, the arrestance in per cent is not usually a factor of density. It may be and it may not, but depending upon the type of dust, but the

(Testimony of Frank P. Rowley.)
actual life in hours, which is parallel in a way to the dust-holding capacity, is very materially increased.

For instance, in filter A it increases from 4.8 hours to 43.0, but I should point out that that 43.0 was not actually finished. That was an estimated value.

The last one we have there is for boneblack dust.

But for B-1, for instance, the life in hours from lampblack, the second density there, the second dust, varies from 1.8, which is the next to the lowest of the densities, up to 21.4 hours for the heaviest dust, and so on.

The filter C varies from 2.8 hours to 22.6 hours.

Now, the dust-holding capacities likewise increase at substantially the same ratios.

I have not read filter D in here because actually that is a strainer type. It isn't an impingement filter. [660] These other three are impingement filters.

Q. I hand you Plaintiff's Exhibit 11 and Defendants' Exhibit JJ and ask you to compare the rate of rise of the resistance curve of the Farr filter represented by the patent in suit on Exhibit 11, and the Farr filter exhibit in suit as tested by you on Exhibit JJ. Will you compare the rate of rise of the resistance curves?

A. Well, the rate of rise is more rapid for the filter as reported by me on type Exhibit JJ than it is for the same filter as reported by, I believe, Mr. Duncan on Exhibit 11, even though my velocities were 300 to his velocities of 519.

(Testimony of Frank B. Rowley.)

* * * * *

Q. Have you ever tested the same filter at two different velocities? A. Yes.

The Court: The Farr filter?

The Witness: Not the Farr. The same type of filter. I have tested filters of different types, but not the Farr.

The Court: Oh, I see. Others?

The Witness: Other filters, yes.

The Court: J-5, P-5? Was it P-5? [661]

The Witness: Neither the P-5, because I did not have them when I was running these other tests.

The Court: That was when you wrote this paper?

The Witness: Along about that time. There was another paper.

By Mr. Baldwin:

Q. Is the effect of a change in velocity of a given filter, with all other conditions maintained constantly, is the effect of the change of the velocity alone predictable? A. Yes.

Q. And what effect does a change of velocity have, what would be the effect of that change in velocity on a resistance curve in general?

A. It raises the resistance curve at all points.

Q. Does it change the rate of rise of such a resistance curve? A. Yes.

Q. To what degree?

A. Well, the resistance is varied as some power of the ratio of the velocities varies. For this type of filter, the resistance varies about 1.7 of the velocity rate. In other words, we take the ratios of

(Testimony of Frank B. Rowley.)

the velocity and raise them to 1.7 power and you have the ratio of the resistances. It is often stated as proportion to the square of the velocity. Actually we haven't that 1.7. [662]

Mr. Leonard S. Lyon: Your Honor, in view of the previous answer of the witness——

The Court: Raise your voice.

Mr. Leonard S. Lyon: In view of the previous answer of the witness, I don't think the record is understandable as to what he means by "this type" of filter.

The Court: I don't know what he means by "this type of filter."

The Witness: I mean filters like the Farr.

The Court: You mean filters that use the impingement method?

The Witness: The general impingement method, that are constructed similar to the Air-Maze and the Farr.

The Court: Well, of course, the plaintiff contends that none of them are constructed similar to the Farr.

The Witness: Well, they all have the same type of resistance elements in them.

The Court: In other words, it is that general impingement type of filter or characteristic of an air-cleaning filter or an oil filter?

The Witness: It is the general principle of mechanics which states that if you have air flowing through a given resistance, a given block of materials, the resistance is proportionate to something

(Testimony of Frank B. Rowley.)

like the square of the velocity, and that is true for all arrangements. It may not always be [663] the square, and this isn't, but it is very close to that.

The Court: 1.7?

The Witness: 1.7 in this case.

By Mr. Baldwin:

Q. Do you have an opinion as to why there is a different rate of rise in the resistance curve in Plaintiff's Exhibit 11 and Defendants' Exhibit JJ?

A. Yes, I do.

Q. What is that opinion?

A. I believe that it was due to a different type of dust used in the test apparatus.

The Court: Did you ever use, in any of your tests, the dust which is described in Plaintiff's Exhibit No. 8 as having been used in connection with the tests made on those filters?

The Witness: No.

The Court AC spark plugs, standardized fine air cooler test dusts?

The Witness: No, your Honor, I never have. I never used that air filter test dust. [664]

The Court: You never used it?

The Witness: I never used it.

The Court: Very well.

The Witness: But it is a very much denser dust from the relation of density to resistance.

By Mr. Baldwin:

Q. I hand you a paper marked for identification Defendants' Exhibit OO—pardon me. I will withdraw that question for the moment.

(Testimony of Frank B. Rowley.)

Are you familiar with the construction of the Air-Maze P-5 filter involved in this suit?

A. Yes.

Q. I hand you a paper marked for identification Defendants' Exhibit OO and ask if you recognize that paper. A. Yes.

Q. What is it?

A. It is a United States patent issued to O. H. Schaaf, dated September 4, 1951, No. 2,567,030, which describes the Air-Maze type of construction and the P-5 panel.

Q. Have you read this patent, 2,567,030?

A. Yes.

Q. In your opinion, does it correctly describe the Air-Maze P-5 filter? A. Yes.

Mr. Baldwin: Your Honor, at this time I offer in evidence [665] Defendants' Exhibits HH, II, JJ, KK, LL, MM, NN, and OO.

The Court: Admitted.

(The documents referred to were received in evidence and marked Defendants' Exhibits HH, II, JJ, KK, LL, MM, NN, NN-1, NN-2, NN-3 and OO respectively.)

[Printer's Note: Defendants Exhibits HH, MM, and OO are reproduced in Book of Exhibits.]

The Court: Are you offering this in connection with the special defenses raised by your answer, this Patent No. OO?

Mr. Baldwin: No, your Honor.

(Testimony of Frank B. Rowley.)

I don't recall whether I offered Defendants' Exhibits DD, EE, FF and GG. If not, I offer them at this time.

The Court: They are admitted.

> (The documents referred to were received in evidence and marked Defendants' Exhibits DD, EE, FF and GG respectively.)

By Mr. Baldwin:

Q. Professor Rowley, will you describe the construction of the Air-Maze P-5 filter panel briefly?

A. The Air-Maze P-5 consists of layers of corrugated screen, the corrugations being in the form of Zs and they are assembled one above the other in such ways that the corrugation lines cross.

Q. What is the nature of the contact between the adjacent layers of the crimped screens?

A. It is virtually a point contact.

Q. I hand you Plaintiff's Exhibit 6, which is the filter [666] media of the Air-Maze P-5 filter, and ask you to take two adjacent layers of that filter media and following a single crimp of one layer will you state how many corrugations or crimps of the adjacent layer are crossed?

A. I would say that it varies a little with the shifting, but about five, four to five points probably.

Q. I think you misunderstood my question. I asked how many corrugations of one screen are crossed by a single corrugation of the other.

A. I thought you asked me the points. I will change that then.

(Testimony of Frank B. Rowley.)

I would say four, at least four.

Q. And how many points of contact between the crimp of one screen and the crimps of the layers of the adjacent screen?

A. I think there are about five.

Q. Now if you take two adjacent layers of that filter media and follow along the single crimp of one layer through the filter panel from one face to the other, what is the nature of the opening between the two screens as you travel along that one crimp using it as a guide line?

A. Well, the nature is, first, where it passes over the crimp it is sort of a triangular opening and then expands into a larger, sort of a diamond-shape, which is equal to the size between the two crimps, and then goes back to [667] the triangle again. It varies in size as it passes through the filter.

Q. Do you find any passageway through the filter from one face to the other of a uniform cross-section? A. No.

The Court: What is that, do you find any pathways through the filter of a uniform cross-section?

The Witness: I understood that to mean any tube-like pathway. Of course you can follow in one groove but they don't go to the extent of the other screen. I understood any pathway bounded by the two screens.

The Court: Well, there are pathways there. That is what you are talking about, is it not?

The Witness: I think there might be a little misunderstanding as to whether we are talking about

(Testimony of Frank B. Rowley.)

a pathway as just the groove in the screen or whether we are talking about the pathway which is confined between the two screens. If the pathway was to mean just the channel or groove in here (indicating), that would be different than if it meant the channel confined above and below the two screens.

Mr. Baldwin: I asked him to define the nature of the space between two adjacent layers.

The Court: I did not understand that to be your question. Let me hear it again.

> (The question referred to was read by the reporter as [668] follows:
>
> ("Q. Do you find any passageway through the filter from one face to the other of a uniform cross-section?")

The Court: I do not understand the question, any passage through the filter of a uniform cross-section.

Mr. Baldwin: Let me ask this question:

Q. Are you familiar with the Farr patent in suit? A. Yes.

The Court: Well, there are passageways through that filter.

The Witness: Yes.

The Court: Of a uniform cross-section. What does he mean by that?

The Witness: I take it that we are discussing one of these passages through here in combination with the next screen above and those, if we follow

(Testimony of Frank B. Rowley.)

this channel through, varies because the crossing channels from above are crossing it so it changes in size or area. If I were to follow this crimp——

The Court: But I still do not understand what you mean by a uniform cross-section. Those passages, if they are zig-zag are going to be alternate and they are going to be the same, and if that is a uniform cross-section there are passageways through it. [669]

The Witness: I suppose if we take the whole area it is a uniform passageway over the whole area, but if we follow one passage through here then the area of that passage is different when it crosses the next screen above it, when it cross the corrugation of the next screen above. The area between this crimp and the one above varies in size as we follow one of these crimps.

The Court: But it is still a passageway through there.

Mr. Baldwin: But a non-uniform cross-section, is the point he is making.

The Court: You mean it is not a uniform passage?

Mr. Baldwin: That is correct.

The Court: Very well.

By Mr. Baldwin:

Q. I hand you Defendants' Exhibit J and I ask you whether the red and green lines correctly represent the crossing ridges of two adjacent layers of the crimped screen in the P-5 filter panel.

A. Yes.

(Testimony of Frank B. Rowley.)

Q. Do the small circles represent the crossing points which I had you count a while ago?

A. Yes.

The Court: I am still thinking about that other answer. You say there is not a uniform passage?

The Witness: It is not uniform if we follow through—— [670]

The Court: It is not uniform to the opening.

The Witness: It is not uniform area. It changes form as it passes over the various parts between the contact points of the upper and lower screen.

The Court: That is to say, it goes through the interstices?

The Witness: I don't mean the interstices between the screens.

The Court: I know, in the humps.

The Witness: If it were a solid material.

The Court: Instead of going through the hump, it goes over the hump?

The Witness: No, it isn't that. Instead of using screens in these two materials here if we used a solid material we would still have that.

The Court: We had a demonstration of that here.

The Witness: We would have that changing cross-section if you followed one of those channels through. Of course it does actually go through the screen too.

The Court: Go ahead with your examination.

Mr. Baldwin: I am having another exhibit marked.

(Testimony of Frank B. Rowley.)

The Clerk: PP.

(The article referred to was marked Defendants' Exhibit PP for identification.) [671]

By Mr. Baldwin:

Q. I hand you a piece of metal marked for identification Defendants' Exhibit PP and ask if you can state what it represents.

A. This represents the space for the air and dust to pass between the screens. It represents the area between two screens eliminating the fact that we have screen members. If these screens were solid material and this then would represent the open passage through the solid material.

Q. Can we say that that metal represents air?

A. That metal represents the air space or air in there; that is correct. That is the space between those two corrugated screens.

Mr. Leonard S. Lyon: Maybe your Honor might ask if that is not a core of the device?

Mr. Baldwin: The metal represents the air between two screens as near as we could cast it.

Q. What do those holes in Exhibit PP indicate?

A. They indicate the points where the corrugations cross, the contact points.

The Court: In other words, that is solid?

The Witness: If you freeze the air and take it out, I suppose that is one way you would have that area.

(Testimony of Frank B. Rowley.)

By Mr. Baldwin:

Q. I have handed you Defendants' Exhibit J. Do the [672] small black circles properly represent the points where the ridges of one layer cross the ridges of an adjacent layer in the Air-Maze P-5 filter? A. Yes.

Q. Following the single arrow on one side and considering that to represent a small jet or stream of air entering at a single point on the entrance face of the P-5 filter, what is the nature of the flow of air through that P-5 filter panel after it leaves the front face of the filter on its way through?

A. Well, the nature of the flow is in the general direction from front to back. The air, however, being split into different channels each time it approaches one of these circles or points. Now it splits in that path first into two, then later divides again each of them, making three, and it divides four times, and actually that stream of air could come out in six different streams provided that this filter was built of something which wouldn't let it pass through the screen, if we considered that possible. That is a possibility of the division of these channels or passage-ways through the filter.

Q. Do I understand you to mean that the heavy dark wavy lines of Exhibit J indicates the passage of the air through the screen or independently of the screen?

A. Independently of the screen. [680]

Q. You have stated you are familiar with the construction of the Farr patent in suit. When a

(Testimony of Frank B. Rowley.)

stream of air enters at a given point at the entrance face of the Farr filter panel, how many directions can it move laterally without going through the screen of the mesh members?

A. It just moves in one channel.

Q. And the action shown in Exhibit J of the Air-Maze P-5 would be possible or impossible, in your opinion, in the Far patent structure?

A. It would be impossible.

The Court: You mean that it would move into the Farr device if it was not screened material, if it was solid material?

The Witness: That is right. I am assuming that these channels are bound by other material.

The Witness: That is right. I am assuming that these channels are bound by other material.

The Court: And the same assumption as your P-5 filter?

The Witness: That is correct. It shows the difference in principle of the two filters.

The Court: But neither of them are made of solid material. It does not call for it to be made of solid material.

The Witness: No, but in so far as it seems to me the Farr filter functions to have open channels going through which illustrate that principle. Otherwise it would be no different than any other filter with open screens, it seems to me. [681]

The Court: Well, actually there is a considerable turbulence in the breaking up of the air. It would

(Testimony of Frank B. Rowley.)
be impossible to follow the stream of air flowing through either one of them.

The Witness: Yes. In all filters that is true.

The Court: In other words, it goes around and over the screen. That is the purpose of it.

The Witness: That is true. The principle in filters is the fact that one filter is designed with a special channel. But that doesn't change the principle of the filter.

The Court: The idea is to create turbulence of change of direction to bring it into contact with your material?

The Witness: That is right. You see, in many filters they create this turbulence and get the surface contact by different kinds of fibers or filaments. For instance, they use animal hair and fiberglass, steel wool and many kinds of material.

Now screen is another way of getting a lot of filaments put together and it has been used that way many times. It is just a matter of getting more filaments in the ordinary manner in the filter. If you put a screen there regardless of how you try to direct the air of that screen it is going to go through the screen in one case the same as the other.

The Court: If the air were introduced at a higher rate of speed into either one of the filters there would be [682] more turbulence?

The Witness: In any filter that is true.

The Court: In any filter?

The Witness: Yes.

The Court: There would be more tubulence?

(Testimony of Frank B. Rowley.)

The Witness: There would be more turbulence, and the resistance would vary with how close the impact was with the first filament in the filter and also the filter efficiency. [683]

By Mr. Baldwin:

Q. Professor Rowley, does the Farr patent state that all of the air flows through the openings in the screen of the mesh members?

A. No, it doesn't.

Q. Does the Farr patent state that some of the flow is down the triangular passageways?

A. Yes.

Q. Is that the kind of flow which you have been trying to describe in the Farr and the Air-Maze P-5 filters? A. That is right.

Q. And it flows down the passages in the Farr patent, how many passages could it flow down?

A. After it enters the filter, it could flow in only one, out past the other screens.

Q. And in the Air-Maze P-5, after it enters the face of the filter, if you regarded the screen as forming passages, how many passages could it flow down?

It could increase on the way through, and as it continued forward on the way it would come out in six passages.

Q. I hand you Plaintiff's Exhibit 9, which purports to show the loading of dust upon the filter media of a filter constructed according to the Farr patent in suit. Would you examine the photograph marked 9-E, in which the plaintiff has stated the

(Testimony of Frank B. Rowley.)

air movement is upward from the bottom of the [684] picture, and state the nature of the loading in the crimps of the screen mesh material?

A. Well, from the photograph it would appear to me that the loading is largely in the entering face and in the entering side before it comes to the angle or bend in the crimp.

Q. And where do you find the bulk of the dust deposited in the Farr filter construction?

A. From the photograph it appears to be in the entering side, I would say of the first third or a little more of the filter up to the bend.

Q. Before it reaches the bend?

A. Before it reaches the bend.

Q. I hand you Plaintiff's Exhibit 14 and call your attention to the pictures 14-B, 14-C, 14-D, and 14-E, and ask you to compare the nature of the load upon the screen mesh members in that series of photographs.

A. With the air flowing in the same direction?

Q. The air is flowing from the top down, it has been stated. Take the lower picture in each photograph.

A. Well, the dust here is apparently shown by a lighter-colored photograph, lighter color in the photograph, and at the beginning it seems to be probably heavier, at the entering side. As you come down to those further runs——

Q. Will you name the picture you are looking at? [685]

A. All right. After you come down to 14-D, for

(Testimony of Frank B. Rowley.)
instance, the dust seems to be fairly well distributed between the entering side and the second leg of the Z.

And when you get down to 14-E, which is after five hours of run, it seems to be generally distributer, just a little heavier on the entering side, but it seems to be pretty well distributed through the middle leg of the Z, and also there is considerable dust shown on the leaving side of the filter.

Q. Do you find a heavy deposit on the second leg of the Z?

A. Yes, on the last photograph I do, building up.

* * * * *

Q. Will you compare the nature of the loading in Exhibits 14-E and 9-E?

A. Well, in general I would say the loading in 9-E is more concentrated at the entering side of the filter than [686] it is in 14-E.

And in 14-E, the loading is more general through the filter.

One would represent to me face loading, heavy, and the other would be more of a general distribution of the load through the filter; that is, the 14-E has the more general distribution of the load through the filter than does the load of 9-E.

The Court: By the way, I wish to understand your testimony a little more clearly in connection with the assumption that both the Farr and the P-5 would be made of solid material and not screen, and that air entering in the P-5 filter can come in

(Testimony of Frank B. Rowley.)

one and can go out six. I understand this Exhibit PP here to be a cast between the screens and that the ridges here show the nature and the direction of the flow of air.

The Witness: And the possibility of it, that is right.

The Court: I have taken one entrance here and marked it, one side of it, with a red pencil, and I have taken the same and marked the other side of it with a red pencil, and they both come out one, there is only one hole for them to come out, isn't there?

The Witness: Your Honor, I could show you here, taking two crimps, where they come together.

The Court: Let us take the one I have marked with the red pencil. [687]

The Witness: All right. Take the one at the top, which is marked with a red pencil?

The Court: Yes. If I understand you correctly, now, that is the only way that air could flow if the screen material were solid.

The Witness: That is one way, that is right, assuming it is a solid material.

The Court: If it were solid, it could not get over into the other one.

Mr. Baldwin: The question was whether that was the only way it could flow.

The Court: If it were solid.

The Witness: If it were solid, that is not the only way it could flow or enter into this cell, that air which is passing along this opening, which is

(Testimony of Frank B. Rowley.)

solid, for some of it can go down into this opening (indicating).

The Court: Down into this opening? Let us follow that with the red pencil, and they both come out at the same opening.

The Witness: But when this gets in here (indicating), it can go across to that (indicating).

The Court: But it can't go across there if the material is solid.

The Witness: But this is opened material. This represents not solid material but air space. [688]

The Court: I can see what you mean, these represent air spaces, and the grooves here represent solid material?

The Witness: It can come here (indicating). This space is connected right across to this one (indicating), it can go in there and then down here (indicating) and go in that direction.

The Court: Wait a minute.

Mr. Baldwin: The metal was air, Your Honor.

The Witness: Every time it meets one of those, it splits.

The Court: Every time it meets one of them on the other side?

The Witness: That is right. And it can split and go in the other direction.

The Court: Well, I will play with it a while. Maybe I can understand it.

By Mr. Baldwin:

Q. Professor Rowley, you have stated that you understand the construction of the Niestle Patent

(Testimony of Frank B. Rowley.)

No. 739,956, is that correct? A. Yes. [689]

* * * * *

Mr. Leonard S. Lyon: May it please the Court, regarding the stipulation that was tendered by counsel at the close of the session yesterday afternoon and which appears at the bottom of page 692 of the transcript:

"Mr. Baldwin: Your Honor, I think I can stipulate the we will not contend that there is anything wrong with Professor Duncan's apparatus or the way he operates it; that if all conditions are the same, Professor Duncan can get an accurate result the same as Professor Rowley could."

Of course as to the first part of the stipulation, we are willing to accept that, but if it is conditioned on the second part of the stipulation we cannot because our client feels that it has perfected the technique, the test technique, and is thereby able to get reproducible and more accurate results than could be gotten with the older technique without those perfections and developments. [697]

The Court: Do you accept the stipulation as modified?

Mr. Baldwin: Yes.

* * * * *

By Mr. Baldwin:

Q. I hand you Defendants' Exhibit PP and a piece of metal marked for identification Defendants' Exhibit QQ-1, and ask you if you can state the relationship between these.

A. Exhibit QQ-1 is a piece of metal cut out of

(Testimony of Frank B. Rowley.)

Exhibit PP and is cut out along one of the corrugation lines, looking at it from either side, and it is cut out in such a way as to follow the ridge of that corrugation throughout the section.

In other words, it is one of those corrugations on one side.

Q. Now I hand you two pieces of corrugated plastic marked for identification QQ-2 and QQ-3, and ask if you will place those in their proper position to illustrate QQ-1

A. Take the section Exhibit QQ-1 and place it so that the ridge corresponding to the corrugation——

Q. The Z-form corrugation?

A. The Z-form corrugation. It fits into the Z-form corrugation.

The Court: Between 2 and 3?

Mr. Baldwin: The green one is QQ-3, your Honor.

The Witness: Into the corrugation of QQ-3, and then I will place the plastic Exhibit QQ-2 in its correct relation to the Exhibit QQ-3 in so far as its relation would be in the filter if the plastic represented screen elements of the filter in that position.

It will be noted that on the one side the line of the metal section follows directly through a corrugation, while on the other side the metal section shows the crossing paths on the opposite side of the filter, or shows where the paths [699] on one side join the paths on the other.

(Testimony of Frank B. Rowley.)

The Court: Let me see it.

(The exhibit referred to was passed to the Court.)

By Mr. Baldwin:

Q. Now the one trough of corrugation on the green side, or QQ-3, crosses how many troughs on the red side or QQ-2?

A. It actually crosses five between the filter and two, one on each edge, which is five troughs across within the filter, and then there is a trough or entrance in the leaving side, both. [700]

Q. Will you please re-examine the exhibit and see if some of the five you have counted are not in the same trough, in other words, how many different troughs on the red side, on QQ-2, are involved?

A. Well, there are two of those near the top and two on the bottom which are the same trough, that cross in and out. I counted each crossing of roughs.

Q. So, how many different troughs are involved on the red side of QQ-2?

A. On the different troughs, there are three.

Q. And in each of those places is there free air communication between the troughs or corrugations of one screen and the troughs or corrugations of the facing screen? A. Yes, there is.

Q. Put this down here.

Now, will you take QQ-1 and explain the answer to a question asked you yesterday afternoon, following down one corrugation as the line of direc-

(Testimony of Frank B. Rowley.)

tion of one screen, will you state the nature of the air passageway between the two screens as you follow through the filter panel from one face to the other?

A. Well, the passageway is in cross-sectional area. As you start out with a triangular section near the entrance side, it runs into sort of a triangle and a rectangular section where it is enlarged. Then it comes down again to [701] a triangular section where it is making a bend, where it comes across the trough the second time, and it alternates down between the larger sections which are made up really of two triangular sections, at right angles to each other, and the smaller sections which are triangular. It follows in cross-section from one section to the other alternately through the paths from the front to the rear of the filter.

The Court: Does that make any difference in the effectiveness of this filter?

The Witness: Well, it does to this extent, your Honor: These larger cross-sections are the air streams which would be entering from another angle, from the other side of the filter, and wherever one of those enlargements is, the two streams of air are coming together at a diagonal, and that coming together creates a turbulence in the filter, or a rolling action.

The Court: Naturally, they are not two separate streams, are they?

The Witness: Well, we are assuming that these screens now have been plugged up with dust in

(Testimony of Frank B. Rowley.)

operation. When the filter is first put into operation and all the screens open, then the air is going both through the screens and through the channels substantially the same way. But after these screen members——

The Court: Substantially the same way in both devices? [702]

The Witness: Well, both from front to back, through the screens.

The Court: Yes.

The Witness: Now, after the screen meshes become plugged, assuming that they were completely plugged, then the air would pass through a single channel in the Farr filter.

The Court: What difference does that make on this filter, if it is plugged up?

The Witness: They are plugged up to the extent where air can't pass through, and yet they may have some efficiency in the collection of dust. I think it is a fundamental difference, in the way the filters load and in the way they operate.

The Court: For all commercial and practical purposes, when the filter falls below 70 per cent efficiency, it means that it is dirty and should be cleaned, is that right, or isn't it?

The Witness: Well, you might set it there or you might set it lower. Sometimes people will take the lower efficiencies and take out the heavy dust, or something like that, and in other cases they might want to take them out and change them even when they are down to 90, so you can't set any

(Testimony of Frank B. Rowley.)
particular place, but it is a question of loading the filter.

If the filter is loaded when all the screens are plugged [703] up, there still may be some chance of filtering. And furthermore, as a part of the screen is plugged up, then this rolling action takes place and you get that turbulence.

In the Farr filter in the catalog, they show that as the air impinges on the entering side of the tube, the channel, it fills the interstices or meshes of the screen on the impinging side and gradually turns that air stream down the tube, the channel.

Now, in the Air-Maze filter, it doesn't do that, because the air stream is separated immediately into two channels, and, as they are filled up, those two air streams will be separate and spread by the filters, spread over the full filter area regardless of whether the meshes were filled with dirt or not.

By Mr. Baldwin:

Q. Do you find in the Air-Maze P-5 any single pathway through the filter of uniform cross-section?

A. No, not between the screen members, you mean.

Q. Is the principle which you have just been trying to explain, about the division of the air stream in the Air-Maze P-5 filter independently of flow through the screens, represented accurately in Defendants' Exhibit J, in your opinion?

A. Yes; it is the same principle.

Q. I hand you Plaintiff's Exhibit No. 13. [704]

The Court: That is when it is clean?

(Testimony of Frank B. Rowley.)

The Witness: No. When it is dirty, your Honor, actually. When it is clean——

The Court: But when it is dirty, this is the way it flows?

The Witness: But when it gets more and more dirty, then it begins to separate. I think that we have to assume, in any filter, when it is clean there is a large amount of air going through the screens.

By Mr. Baldwin:

Q. I hand you Plaintiff's Exhibit No. 13, which is the comparative test by Professor Duncan of the Farr filter and the Air-Maze P-5 filter, and call your attention to the resistance curves which are substantially identical for the first 400 grams of load and thereafter the curve as to the Air-Maze P-5 rises more rapidly than the curve of the Farr air filter. Have you an opinion as to why that difference occurs? A. Yes.

Q. Would you explain your opinion?

A. I think that, as these filters were loaded with dirt, they gradually filled the screen meshes on the entering side. Then they begin to take on this action which I have just described, due to the flow of the air through the channels that are formed by the corrugations. [705]

And in the Farr filter, when those meshes on the entering side are filled, the stream of air is directed down a single channel, for each one of the separate channels, in a definite direction.

Now, in the Air-Maze filter, regardless of whether those are filled or not, you have that rolling action,

(Testimony of Frank B. Rowley.)

mixing action, which agitates the air stream and gives you turbulence all through the filter, and that turbulence does require some pressure drop upon the turbulence. It takes energy. And that pressure drop is illustrated, in my opinion, by the difference in pressure drop between the two filters under the same test conditions. [706]

The Court: On this Exhibit 14-E, the photograph of the P-5 filter, the testimony was that the air was introduced at the side which is shown here at the top.

The Witness: Yes.

The Court: All those accumulations are on one side of those ridges down to the exit side, and then they appear to take a reverse and get on the other side.

The Witness: Well, those accumulations are due to the——

The Court: Just a moment. That is not correct. Both in 14-D and 14-E, the first zig in the Z, the accumulation appears to be on the right side, that is, the right side of the photograph.

The Witness: Yes.

The Court: Then on the next zig of the zag it is on the left side and the exit is again on the same side as the entering side.

What would that indicate?

The Witness: Well, that indicates that there is a considerable amount of the air flowing straight through the filter and the meshes haven't been plugged up completely, and of course it is a flow

(Testimony of Frank B. Rowley.)
through the meshes, and that would collect the dust on the entering side more than it would on the exit side of the screens. But I think as it gets further into the filter it shows more collection on there, and if there had been more tests for a longer period it probably [707] would have plugged up some of those meshes and would have had a different action in the loading throughout the filter.

I think this shows that the loading through this Air-Maze filter is beginning to get fairly uniform. It doesn't——

By Mr. Baldwin:

Q. Professor Rowley, does not the dust collect on whichever side of the crimp is inclined against the stream of air?

A. Yes, that is in general true. It is the side that is struck by the dust which would collect the dust.

Q. And if in one layer in the Air-Maze P-5 the dust collection was on the right-hand side of the crimp in one of the photographs of Plaintiff's Exhibit 14, where would the collection be on the next adjacent screen which criss-crosses?

A. Well, if it was separated as these appear to be, and we are looking at the section of the filter, one being the bottom of the filter and the other the top, then it would naturally be on the opposite side.

Q. Looking at Exhibit 14-E, what is the relationship when the filter is put together of the upper and lower screens photographed there?

(Testimony of Frank B. Rowley.)

A. Well, I am not sure how they turned this, but if it were just cut and turned back, then the lower screen would be really folded up and put onto the upper screen.

Q. And the Z form of crimp which appears in both the [708] upper and lower portion of Exhibit 14-E appear to extend in the same direction when the filter is put together. How would they extend?

A. They would be in the opposite direction when assembled.

The Court: In other words, if this on top were laid on the bottom that would be the construction of your patent?

The Witness: Assume that that was cut open and laid out there.

The Court: They both run the same way here and it would run opposite.

The Clerk: Exhibit RR marked for identification.

(The article referred to was marked Defendants' Exhibit RR for identification.)

By Mr. Baldwin:

Q. I hand you some pieces of plastic marked for identification Defendants' Exhibit RR and ask you if you will identify it and explain it, if you can.

A. This is a small model which I made up last night in an attempt to show the direction of flow through the Air-Maze P-5 filter, what may happen to a stream of air entering the filter.

Q. You mean independently of opening in the screen?

(Testimony of Frank B. Rowley.)

A. Independently of openings in the screen.

The Court: That is assuming that the screen was an [709] impervious material?

The Witness: That is correct.

Now it was made up of two plastic corrugated sheets and put together so that the opening at the top, as I hold it here, represents the entrance, or may represent the entrance of air into the filter.

Now if a stream of air enters the filter in one of these openings coming down between the two corrugations, it will be noted that one side runs in one direction and the corrugation of the other plastic runs in the other, so that the stream of air first splits and goes, part of it, in each direction.

Then as the stream of air comes over the ridge on the other corrugation on the other side, or in other words wherever two of these red lines cross on on each side, there the air is able to pass across to either side of the filter. That is, there is a connection clear through both corrugations, and it may pass down one of two channels at each crossing, and that air which enters in one place at the top of the filter, one opening, may separate and leave in at least six openings at the bottom.

The Court: Six?

The Witness: Into those six tubes.

The Court: Five, is it not?

The Witness: Pardon me. Maybe I miscounted it. [710]

The Court: 1, 2, 3, 4, 5.

The Witness: Well, at any rate it depends on

(Testimony of Frank B. Rowley.)

how long it separates and goes through those openings and branches out as it goes on through the filter. That was to illustrate the spreading out laterally in the filter.

The Court: Very well.

The Clerk: Exhibit SS for identification.

(The article referred to was marked Defendants' Exhibit SS for identification.)

By Mr. Baldwin:

Q. I hand you a model marked for identification Defendants' Exhibit SS and ask if you will describe it and explain what it illustrates, if you can.

A. This model SS is made up of two plastic corrugated sheets which represent the corrugated mesh material used in the Air-Maze P-5 without corrugations, a solid material, and——

The Court: Without corrugations?

The Witness: With the corrugations but there is no mesh.

The Court: Impervious.

The Witness: An impervious material; that is correct.

And then it shows a series of colored strings entering one side and passing down through, or through between those two corrugated plastic sheets in channels which I think might take, or which air might take, in passing through the filter, [711] that is, showing that we might start in one place and spread out.

In this case there are eight strings passing

(Testimony of Frank B. Rowley.)

through but, as a matter of fact, every time a corrugation on one side crosses a corrugation on the other there is a connection between and you could travel from one side to the other right through those corrugations so far as the opening is concerned.

By Mr. Baldwin:

Q. Will you state whether or not those strings pass through openings that are just substantially the size of the piece of string or whether the openings are larger?

A. They are large openings, at least the triangular openings illustrated in the metal sample I showed.

The Court: Let me see it.

(The article referred to was passed to the Court.)

Mr. Baldwin: Will you mark this, please?

The Clerk: TT.

(The article referred to was marked Defendants' Exhibit TT for identification.)

By Mr. Baldwin:

Q. I show you a model marked for identification Defendants' Exhibit TT and ask you to describe what it explains or what it represents.

A. This is a plastic model .built up of two' corrugated [712] plastic discs, which are impervious, and corrugation is in the Z form as in the P-5 Air-Maze patent, and it represents by strings,

(Testimony of Frank B. Rowley.)
two strings, one red and one white, passages which are open to the model.

The Court: From end to end?

The Witness: The red string is from end to end and the white one from one side up and then back down.

By Mr. Baldwin:

Q. Professor Rowley, state whether or not in your opinion Defendants' Exhibit TT for identification illustrates whether or not the screen mesh members of the Air-Maze P-5 filter divide the space between adjacent screen layers in a lateral direction.

A. It shows that they do not divide it in a lateral direction.

The Clerk: Exhibit UU marked for identification.

(The article referred to was marked Defendants' Exhibit UU for identification.)

By Mr. Baldwin:

Q. I hand you a model marked for identification Defendants' Exhibit UU and ask you to explain what it illustrates, if you can.

A. This is a plastic model which is built up of alternate plain and corrugated sheets, the corrugations representing the corrugated mesh screen used in the Farr patent [713] and represents the openings which are formed by the screens from entrance to exit in the Farr construction. And in this model there are seven different colored strings that run through the channels or tubes which run from one

(Testimony of Frank B. Rowley.)

side of the filter to the other and shows that there is no connection between those tubes where there is no mesh in the screen but solid material.

Q. In the imperforate model, Defendants' Exhibit UU for identification, is there more than one opening through the model which any one of those strings could traverse?

A. When the string starts in one channel it must go through that channel. It can't go from one to the other within the filter model.

Q. Professor Rowley, when we discussed Defendants' Exhibit LL, which is the 7 x 7 panel constructed according to the Niestle (French) patent, at the close of your testimony regarding your test data as shown on Defendants' Exhibit——

The Court: Pardon me. Did you make up the model of this without the flat layer in between showing the Farr device, the crimps superimposed on one another directly?

The Witness: I didn't, your Honor, but if they were meshed as shown in the patent it would be the same thing, if the crimps were mershed one with the other.

The Court: I understood that in the Farr patent these [714] do not lie like this, they lie opposite, so that one layer crimps to the right and left and the other one would go from left to right, the elbow crimp.

Where is that model?

The Clerk: Exhibit 3?

(Testimony of Frank B. Rowley.)

(The exhibit referred to was passed to the Court.) [715]

The Court: They all lie the same, don't they?

The Witness: Yes, that is correct.

The Court: All right. Proceed.

By Mr. Baldwin:

Q. Professor Rowley, I call your attention to Fig. 4 of the Farr patent in suit and ask you to say whether or not the herringbone crimps turn in opposite directions or all in the same direction.

A. They turn in the same direction.

Q. Is there any teaching in the Farr patent in suit of turning the herringbone crimps in opposite directions? A. Not that I am aware of, no.

Q. Is there any teaching in the Farr patent in suit, so far as you know, of leaving out the flat screen member 9? A. No.

Q. Professor Rowley, at the close of your testimony regarding Defendants' Exhibit LL, the 7 by 7 filter constructed according to the French patent to Niestle, after you had submitted your data which is shown on Defendants' Exhibit MM, as related to your test of that Exhibit LL, I asked you whether or not in your opinion, based on your consultation work, you would know what modification to make in Exhibit LL to produce a lower resistance. My recollection of the record is that you answered "Yes" to that question.

A. That is correct. [716]

Q. Is that your present opinion? A. Yes.

(Testimony of Frank B. Rowley.)

* * * * *

Q. You stated, in part of my examination previously, that you had consulted with filter manufacturers in the development and modification of specific filters, is that correct? A. Yes.

Q. Did you ever consult with a manufacturer on the problem of reducing the resistance through a specific filter? A. Yes.

The Court: The Niestle filter? Did you ever consult with him about a filter on that?

The Witness: No, not Niestle.

By Mr. Baldwin:

Q. Would you state the nature of the filter on which you were consulted? [718]

* * * * *

A. It was a viscous filter, a type of filter manufactured by the Owens-Illinois Glass Company, now the Owens-Corning.

The Court: Viscous?

The Witness: They call them viscous type. It is fibrous.

By Mr. Baldwin:

Q. You mean impingement type?

A. Impingement type. We sometimes call them a viscous type instead of impingement.

The Court: The impingement type made out of fibrous glass?

The Witness: Fiberglass, that is right.

The Court: When was that? [719]

The Witness: That was about—prior to 1937.

* * * * *

(Testimony of Frank B. Rowley.)

By Mr. Baldwin:

Q. I hand you Defendants' Exhibit NN (handing exhibit to the witness).

The Court: We only have one copy of that.

Mr. Baldwin: Yes, sir.

Q. (Continuing) And ask you whether or not any of the data and reports in that exhibit relate to the Arco filter which you have testified was constructed according to the Kaiser and Manning patents. A. Yes.

The Court: He testified to that yesterday.

Mr. Baldwin: Yes, he did.

Q. Would you call attention to where that Arco filter and records or data appear in this bulletin, Exhibit NN?

A. Well, there are several places where the Arco filter is referred to.

Q. I would like you to confine your answer to where the [721] efficiency is reported.

A. (The witness examines said exhibit.) It is, I would say, on page 5, Fig, 4, in one place, where it is reported in curves. [722]

* * * * *

Q. I call your attention to table 3 at the bottom of page 3. Is this Arco filter mentioned there?

A. Yes.

Q. Insofar as efficiency or arrestance is concerned? A. Yes, it is.

* * * * *

Q. Would you read the arrestance figures of the Arco filter if they appear on table 3?

(Testimony of Frank B. Rowley.)

A. The arrestance figures in percentage run from 77.7 for Pocahontas ash, one type, 84.9, 81.6, and 83.3 for Illinois fly ash.

The Court: For what?

The Witness: Illinois fly ash.

The Court: Illinois fly ash? [723]

The Witness: Illinois fly ash. Illinois coal fly ash.

The Court: That is a new one to me. That is the first time I have heard of that.

The Witness: We designate the different fly ashes by coal. We call it Illinois coal fly ash.

By Mr. Baldwin:

Q. I call your attention to Fig. 8 on page 7 and ask you if you find there anything relating to the resistance of the Arco filter.

A. Yes. There are resistance curves here for different types of carbon dust when used in the filter.

Q. What does it show to be the resistance of the filter when clean?

A. It is .15 inches.

Q. I believe you stated previously, but will you repeat, how the Arco or Detroit type air filter, which you have testified it was, is designated in this bulletin? A. As filter C. [724]

Q. Have you ever known of filter panels to be placed in series in the use of filters?

A. Yes.

Q. Where and when did you know of such an arrangement?

(Testimony of Frank B. Rowley.)

A. Well, they have been used in filter installations at least since 1934 and they are so shown. I have tested them myself in tandem as early as 1934.

Q. You have tested them?

A. Yes. And they are shown in the ASH and VE 1934 guide as installed in tandem.

Q. Professor Rowley, have you ever tested the same filter with a dust free of lint and with a dust containing lint? A. Yes.

Q. Would you state the effect on test results when the test dust includes lint or is free of lint?

A. Of course it depends on the type of lint and how much, but the general results are that if there is lint in the dust it will plug up the filter faster and the resistance will increase more rapidly. The life of the filter will be reduced by the use of lint in the dust.

Mr. Baldwin: That is all. You may cross examine. [725]

* * * * *

Mr. Baldwin: If the Court please, I would like at this time to offer in evidence Defendants' Exhibits PP, QQ, RR, SS, TT, and UU. They are all those models.

The Court: Admitted in evidence.

(The articles referred to were received in evidence and marked Defendants' Exhibits PP, QQ, RR, SS, TT and UU respectively.)

Mr. Harris: At this time, Your Honor, I would also like to offer Defendants' Exhibit A, which

(Testimony of Frank B. Rowley.)

is the P-5 obsolete model, Defendants' Exhibit D, which is the Farr round filter, Defendants' Exhibit E, which is the Farr bulletin 100-1, Defendants' Exhibit F, which is the Farr bulletin 100-4, Defendants' Exhibit G, which is the 7 x 7 Farr specimen, Defendants' Exhibit H, which is the Farr bulletin F-161, Defendants' Exhibit I, which are the two plastic strips with the red and green strips, Defendants' Exhibit J, which is the sketch that has been referred to.

The Court: Admitted.

(The articles referred to were marked Defendants' Exhibits A, D, E, F, G, H, I and J respectively and received in evidence.)

[Printer's Note: Defendant's Exhibits E and J are reproduced in Book of Exhibits.]

Mr. Harris: Also, Your Honor, Defendants' Exhibit V, Defendants' Exhibits V and W, which are these brass screen wire specimens.

The Court: On the St. Cyr patent?

Mr. Harris: On the St. Cyr patent. [726]

The Court: Admitted.

(The specimens referred to were received in evidence and marked Defendants' Exhibits V and W respectively.)

Mr. Harris: Also Defendants' Exhibit Z, which is a diagram of the Row (British) patent Fig. 2.

The Court: What is that again?

(Testimony of Frank B. Rowley.)

Mr. Harris: It is a diagram of the Row (British) patent Fig. 2.

The Clerk: Exhibit Z is a figure shown in the Farr catalog illustration and the Row (British) Fig. No. 2.

The Court: I do not seem to have Z marked down here.

Mr. Leonard S. Lyon: I don't think there is any foundation for Z. I would like to see it to be sure what Z is.

> (The exhibit referred to was passed to counsel.)

Mr. Leonard S. Lyon: I think the questions were excluded on that.

Mr. Harris: No, this is the one that Mr. Russell identified of the sketch.

The Court: Very well. Admitted.

> (The illustration referred to was received in evidence and marked Defendants' Exhibit Z.) [727]

> [Printer's Note: Defendants' Exhibit Z is reproduction in Book of Exhibits.]

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Cross Examination

By Mr. Leonard S. Lyon:

Q. Dr. Rowley, in your opinion can the curves produced by the test method described by Mr. Duncan and recorded as he has recorded them on

(Testimony of Frank B. Rowley.)

the exhibits in this case, be correlated with the curves which you have produced following the test methods that you used and recorded in the manner that you have recorded them in the exhibits you have produced here?

A. You mean they can be correlated in the understanding from the test result? Yes, I think they are not the same of course because Mr. Duncan used a different velocity than I did. However, you can convert from one velocity to the other velocity by well-known methods. And Mr. Duncan used, I understand, a different method in sampling his air upstream and downstream than I did, but I don't think it is material so long as both were the same.

Now the thing that I think is difficult to correlate between those tests is the fact that Mr. Duncan didn't use the same test dust. He used Arizona dust.

Q. One factor that has to be considered in correlating these curves is the fact that they are drawn on different graph paper, is that not correct?

A. No, that doesn't make any difference. You just [728] convert your scales when you correlate.

Q. Well, that would affect the shape of the curve, would it not?

A. Not necessarily. It depends on what scale you use. You can affect the shape of the curve by selecting different scale on any graph paper.

Q. You used a different scale than Mr. Duncan did? A. Yes.

(Testimony of Frank B. Rowley.)

The Court: It would affect the appearance shape of the curve.

The Witness: Yes, but you take that all into consideration when you are correlating it.

By Mr. Leonard S. Lyon: [729]

* * * * *

Q. In comparing these sheets of test data, the curves on these sheets of test data, one significant thing we have all agreed to is the filter efficiency curve, is that correct?

A. The filter efficiency or arrestance is important.

Q. They are the same thing? [730]

A. They are the same thing; different terms.

Q. And the pressure drop is significant?

A. That is correct.

Q. And the filter rate is significant, the flow rate?

A. The flow rate of air through the filter, yes.

Q. And the loading rate or loading capacity, is that significant?

A. The rate of dust feed, yes.

Q. Well, the loading capacity of the filter, the total loading capacity, is that significant?

A. The load capacity is a result. It isn't something you can determine ahead of time when you are setting up the test. It is the result you get from the test values.

Q. But that result is significant?

A. Yes, that is correct.

(Testimony of Frank B. Rowley.)

Q. Now how do you determine the loading capacity?

A. You measure the amount of dust which you feed into the airstream leading to the filter and then you know the amount of dust fed over the hour period or period of the test. Then you measure the amount of dust in the aid leaving the filter.

Now you subtract the amount of dust in the air leaving the filter from that which enters and that gives you the amount held by the filter. [731]

* * * * *

By Mr. Leonard S. Lyon:

Q. How do you determine when a filter of the impingement type has reached its total dust load capacity?

A. You have to determine, before you start to test, some criteria for that, and one method for the pressure rise—now, you can take either the pressure rise across the filter, the rate, and say that you are going to determine the maximum capacity when that pressure rise has reached a given pressure such as half an inch, or you can take a particular efficiency. When the efficiency drops below a certain level, you can say that that is the capacity of the filter. It depends upon your selection of the limits, and they are both used.

Q. They are both? Either one is arbitrary?

A. Yes. You can select the dust-holding capacity as the amount of dust the filter would hold up to a rise, we will say, of half an inch, or you could go to one inch, it is an arbitrary matter as to

(Testimony of Frank B. Rowley.)
where you select it, but that doesn't change the test method. That is merely procedure.

Q. Now, discussing the variables that enter into these tests, what is the nature of the change in the filter efficiency curve that is made by varying the flow rate, the [734] flow rate through the filter?

A. That depends on several things. It isn't the same for all filters. The flow rate may change the filter efficiency in either direction. That is, you may have a flow rate of 300 feet per minute, we will say, and you might go up to 1,000 feet a minute on a certain filter. You might increase the rate of efficiency percentage or you might decrease it. There is no law that holds for all filters. There is a different action takes place.

Q. What is the nature of the change in the pressure drop curve that is effected by a change in the flow rate?

A. For a given filtering condition, if you load your filter up to a certain condition and take the pressure drop and differ the velocities at that particular setting or loading, the pressure drops varies about as the square of the velocity, it is a little less than the square on these filters, we found it to be 1.7.

Q. Have you ever conducted any experiments, using the type of dust that Mr. Duncan testified he used at the Farr Company, in your testing?

A. No.

Q. Have you any opinion as to what effect, if

(Testimony of Frank B. Rowley.)

any, that would have on either the efficiency curve or the pressure drop curve?

A. I have an opinion of what effect it would have on [735] the pressure drop curve, yes.

Q. What is your opinion?

A. My opinion is that that would flatten out the pressure drop curve and give us loading with less pressure drop.

Q. Why?

A. On account of the fact I have tested, rated filters with different densities of dust and I find that the pressure drop decreases as the density of the dust increases.

Q. To what extent do you think it would flatten the pressure drop curve?

A. I think it would have a very material difference in it.

Q. Well, can you tell us in what order it would be, in inches of water?

A. I can't tell you in inches of water, because there are factors that enter there, the type of dust and many things enter. I know it would, I know in my opinion that it would materially change that drop in resistance.

Q. Now, what if any tests have you made on the Farr filter, respecting those on which you have brought in the exhibits?

A. To substantiate that, I checked the Farr filter in two or three tests, to determine the effect of different oiling on the filter. I took S.A.E. 30

(Testimony of Frank B. Rowley.)

oil instead of S.A.E. 40, and that gave a little lower efficiency than the [736] S.A.E. 40.

Then I checked two or three runs to determine whether that high efficiency at the start was characteristic of the filter or not, and in those two or three runs it did appear to be.

Q. Were all of those tests made for the purpose of this case?

A. Yes, all of mine. I tested all of those. The Farr filter I didn't test before this case.

Q. When did you first see a Farr filter?

A. I do not remember. I have known of the Farr filter for some time. I can't say when I first saw one.

Q. But you never made any tests on it until you made those that you made for the purpose of this case?

A. No. That is correct.

The Court: Going back to this matter of difference in dust, you said by using the dust used by Professor Duncan the pressure drop would be less?

The Witness: That the increase would be less, that is right, as you built up dust in the filter.

The Court: Well, in your own graphs here, graph JJ or in any one of them, it is your opinion, as I understand it, if I understand it correctly, that if the Duncan dust were used, this lower graph, instead of being up on JJ to about .15, would be lower? [737]

(Testimony of Frank B. Rowley.)

The Witness: Yes, it would be lower, that is right.

The Court: Why, because the dust is finer?

The Witness: It is heavier dust, and it is the volume that fills the filter.

The Court: It is a heavier dust?

The Witness: It is a higher-density dust, more dense.

The Court: Well, is it more comparable to the dust that is in the air?

The Witness: No, sir.

The Court: To be filtered?

The Witness: In my opinion, it is not. It is less comparable.

The Court: It is less comparable than Pocahontas?

The Witness: This Pocahontas ash and carbon has been used and a lot of work has been done on it, and that so far has been the best one that has been devised, that has been acceptable.

The Court: Well, Pocahontas dust, that is carbon and lampblack?

The Witness: Carbon black, lampblack.

The Court: And Pocahontas dust is not the dust that you find out here on the road, is it?

The Witness: No, it is not a road dust, exactly. The road dust is usually very heavy. This road dust you find around the city, and there is not too much matter of that [738] dust in the air.

The Court: There isn't too much of that dust in the air?

(Testimony of Frank B. Rowley.)

The Witness: Not in the filtered air. That is a heavy dust. That is a heavy-type dust.

The Court: I suppose you have windstorms up in your country?

The Witness: That is right.

The Court: In the summer time, and it blows dust. That is not Pocahontas dust, is it?

The Witness: No, sir.

The Court: That is just dirt?

The Witness: Yes.

The Court: Now, if that kind of dust were used in your tests would these lines be any different?

The Witness: It would depend on the density of that dust and the characteristics of it.

The Court: Have you ever conducted a test with just plain old dust?

The Witness: No; not of that type that you mention.

The Court: Well, do I understand you to say that there is less of that type of dust in the air, where filters are used, that is, in and about the cities and say on the coast here and in the desert countries and in the farming areas, than there is of Pocahontas ash?

The Witness: No. I wouldn't want to say that, because [739] you haven't much Pocahontas ash around here. It is that that dust, Pocahontas ash and carbon black, is accepted as the type of dust that is representative of dust in average air, and the point is that—— [740]

The Court: Well, that is mostly found in in-

(Testimony of Frank B. Rowley.)

dustrial sections, where they burn coal, is it not?

The Witness: Well, the carbon is found where they burn oil and coal.

The Court: Coal or oil?

The Witness: Most any district has some carbon black in it. But in comparing filters you have to select some kind of dust, otherwise you have results that wouldn't mean anything. You have to have some kind of dust that is uniform.

The Court: In other words, you have conducted your tests with a type of dust which you used because you believe that provides a better result, that is to say, it is more comparable to the——

The Witness: Than the average dust.

The Court: ——more comparable to the conditions under which the filter would be put?

The Witness: Yes, that is correct.

By Mr. Leonard S. Lyon:

Q. On your Exhibit JJ, you show the pressure drop of the Farr filter when clean and the start of the test to be 1½ inch, is that correct?

A. No, .05.

The Court: Half of a tenth. [741]

By Mr. Leonard S. Lyon:

Q. On Exhibit 13 Mr. Duncan found the pressure drop of the Farr filter when clean to be 1/10th of an inch, just about twice what you found it to be. Do you think that difference was due to the difference in the dust used in the test method?

A. No, that was due to the difference in air

(Testimony of Frank B. Rowley.)

velocity through the filter. There was no dust in the filter at that time.

Q. Due to the difference in air velocity through the filter? A. That is correct.

The Court: In other words, the greater the air velocity it creates more dust, is that it?

The Witness: It creates more pressure drop across the filter. He is referring to the difference——

The Court: I understand.

The Witness: No, the greater air velocity through the filter just simply creates a greater pressure drop across the filter.

By Mr. Leonard S. Lyon:

Q. What did you find the pressure drop to be in the Farr filter as shown on Exhibit JJ after the dust load on the filter had reached the maximum of 656 grams?

A. Do you want the filter resistance? Is that what [742] you asked for?

Q. Yes.

The Court: I thought he asked for the pressure drop.

The Witness: It is the same thing.

By Mr. Leonard S. Lyon:

Q. Pressure drop and filted resistance mean the same thing, do they not?

A. Yes, they do. It is just a different way of expressing it.

The pressure drop at that point was .14.

The Court: Five hundred and what?

(Testimony of Frank B. Rowley.)

The Witness: No., .14.

The Court: He said when there were five hundred and something.

Mr. Leonard S. Lyon: 656.

The Witness: 656 he took as the end point of the curve, I think he is referring to.

The Court: On your Exhibit JJ?

The Witness: Yes.

By Mr. Leonard S. Lyon:

Q. What did Mr. Duncan find the pressure drop to be at that point as reported on Exhibit 13?

A. He found it to be about .112, or something like that.

Q. Now what would you attribute those differences to? [743]

A. Well, a part of it, as I have said, the change from the beginning to that point, is due to the difference in dust. The fact that he is running at a higher velocity all the time would raise his curve at any time above the curve for my test.

Q. If you were asked——

A. Just a minute. Those two are different. The raise in velocity gives the higher drop, higher velocity, but the dust which he is using gives a lower pressure drop as the filter is loaded.

Q. If you were asked to correlate those two curves, the pressure drop curve on Exhibit 13 and the pressure drop curve on Exhibit JJ, what would you say to be the correct curve?

A. Well, by correlating them I would take the one curve, we will say on Exhibit 13, and replot

(Testimony of Frank B. Rowley.)

that on JJ, but I would correct for the velocity difference.

The Court: What would you do to correct it?

The Witness: I would take the same dust load on the filter and plot both curves at the different velocity. That is, I would take my dust load, we will say, on Exhibit JJ, the certain dust load on the filter which I take as 415, and if I was plotting Exhibit 13 on that I would take from Exhibit 13 the dust load on the filter, which would be between 400 and 500 on the horizontal line, 413, I would take [744] the pressure drop as shown there, which is a little above .1 and I would convert that over to the same velocity, that is, to have them on the same velocity.

The Court: How would you convert that to the same velocity?

The Witness: I would take the ratio of the two at .17, that is about 2 to 1.

The Court: You mean 300? Was that the velocity you used? [745]

The Witness: I used 300.

The Court: That would be 300 to 519?

The Witness: It means that if I took my value at 300 and then if I raised the velocity by that same loading to 500, my pressure drop would be just about twice as much. It comes out just about 2 to 1.

By Mr. Leonard S. Lyon:

Q. Is that in direct relationship between one pressure drop and the other?

(Testimony of Frank B. Rowley.)

A. I explained it is proportionate to the 1.7 power.

Q. Now you have shown on Exhibit JJ that the initial filter efficiency which you measured at the end of the second hour was 81.5, is that correct?

A. At the end of the second hour?

Q. Yes. A. Isn't that 80.4?

Q. It seems to be above 81. Where the curve starts, the filter efficiency.

A. Well, yes, the curve is 81.5.

Q. But your actual measurement that you obtained was 80.4? A. That is correct.

Q. Now Mr. Duncan shows on his Exhibit 13, with a dust load of 100 on the filter, that the Farr filter had an efficiency of 78. Do you notice that?

A. Yes.

Q. The nearest point that I can read for a dust load of 100 on your curve shows a measurement of 81, approximately. Do you agree with that?

A. You first said 78. That was 77 I believe on the chart.

Q. All right. I think you are right, 77.

A. Now what was the next part of the question?

Q. I think I can restate it.

What is the nearest measurement you have or value you have on your Exhibit JJ for the Farr filter, filter efficiency at a dust load of 100?

A. That is, you want the nearest on my curve for 100 on the Farr, not on my curve?

Q. On your curve.

(Testimony of Frank B. Rowley.)

A. I don't think I understand your question. You want the point on my curve which corresponds the closest to the 100 load on Mr. Duncan's curve, is that correct?

Q. Yes.

The Court: That would be at the end of three hours, would it not?

The Witness: No, you have to come over on my curve until we get 77 efficiency, the way he is asking the question. 77 efficiency on my curve would be——

Mr. Leonard S. Lyon: No, I am asking you, Doctor, for [747] the efficiency on your curve, Exhibit JJ, for a dust load of 100.

The Witness: For a dust load of 100 on my curve or Mr. Duncan's curve?

Mr. Leonard S. Lyon: On your curve.

The Witness: All right.

On my curve it would be around 81.

By Mr. Leonard S. Lyon:

Q. And that would lie on the curve midway between two points that you actually measured, would it not? A. Yes, that is correct.

Q. And what were the actual measurements on those two points?

A. The measurement on the first point at the end of two hours was 80.4 and the next point was 81 on the end of the third hour.

Q. And the next point after that was what?

A. The next point after that was for the fourth hour, was 80.

(Testimony of Frank B. Rowley.)

Q. What about that point I see up there at 82.6?

A. That evidently is not a point on the curve. The points for the curve are all on the lines. I don't know what that is.

Q. What was that point at 82.6?

A. I don't know what that was up there. [748]

The Court: I think you said yesterday that that is where you tested them, that dot.

The Witness: You are talking about the one at 82.6?

Mr. Leonard S. Lyon: That is right.

The Witness: But that is between 3 and 4. All my test points are directly on the lines that represent the hours.

By Mr. Leonard S. Lyon:

Q. If you had drawn the curve through the first three points that you measured, the curve would start at 80.4, go up to 81 and then go up to 82.6, would it not?

A. No, that 82.6 is not a point on this curve at all. I don't know what that is. My test points are all on the lines, the vertical lines, not between the lines.

Q. I am not asking which ones you drew the curves through, I am asking you which ones you actually measured. Did you make a measurement and obtain a value of 82.6?

A. No. I don't know what that is up there now. It is evidently a spot on the paper.

Q. You have got a point down here at 75.8

(Testimony of Frank B. Rowley.)

aboue dust fed in the amount of 201.5 grams. Was that a measurement?

A. That is a measurement. [749]

By Mr. Leonard S. Lyon:

Q. How do you know that is a measurement and 82.6 is not?

A. Well, my measurements are all on those vertical lines, shown on the main lines. I have no measurements that fall between those lines. I didn't take any between them.

Q. What happened in connection with this point of a dust feed of 20.5 which appears at 75.8 or so?

A. Well, I don't know. It may be that we did not get the complete sample. It might have been a leak past the crucible, something like that. Those are conditions that arise in testing and you cannot get every point to lie on a curve in a test.

Q. When you test and make these curves, do you just disregard those that you think you cannot use in the curve?

A. No. I put those points on to show exactly, when the tests were made, what the results are, and then I draw the curves, my interpretation of the data, but the data is there.

Q. What about the point in your curve above 361.6 dust load, that is up at 80, and you have a curve down at 77.8? A. That is right.

Q. Did you get that measurement?

A. Taking an average through those curves, yes, that is a measurement up there. That is a test. [750]

(Testimony of Frank B. Rowley.)

The Court: What you get is taking an average through the curves?

The Witness: I take an average. You cannot run these filters at given points, in my estimation, to lie straight on the curves. My points fall on both sides of the curve, and I try to follow the curve.

By Mr. Leonard S. Lyon:

Q. When you get the value 80 that appears above 31.6 and get a value for the curve at that point of 77, what other measurement, average with the value of 80, gave you that point on the curve?

A. The other values, you will note, before that are below the curve. Three or four prior to that are below the curve and there are two or three that are above the curve, and I have drawn the curve as a representative curve through those points.

Q. Will you look at the slope of your curve from where it crosses the value of 78 to where it crosses the value of 76. Did you obtain any measurements below that curve to average with those above, to produce the slope of the curve that you have there?

A. No, sir. They are all above in that area, and they are below prior to that and after that. So, if someone wants to take those points and re-plot the curve, they are at liberty to do so. Those are the points I am basing it on. [751]

Q. This dust that you used in the testing from which these curves were made, you used lampblack as one ingredient, did you not?

(Testimony of Frank B. Rowley.)

A. Yes, carbon black.

Q. Carbon black. And don't you know that carbon black has a tendency to agglomerate in your tests?

A. Yes, I know that it agglomerates and also we mix it with other dusts.

Q. You have published your opinion or your findings that that is a difficulty you experience in these tests, have you not?

A. I don't remember that I have ever published it. It is a difficulty, of course, that we have, to get the dust thoroughly mixed with the air. That is the reason we agitate it.

Q. And carbon black has a propensity for agglomerating in the operation of these tests, and you have to be careful with it?

A. Well, it depends somewhat on the carbon black, how they make it, as to how much it will agglomerate.

The Court: When it agglomerates, it catches on the screen, so it is a bigger hunk of dust, is that what you mean?

By Mr. Leonard S. Lyon:

Q. It does not get uniformly dispersed, because it lumps up? [752]

A. Not if you mix it and screen it through the mesh. We mix the dust, and in order to get a thorough mix we screen it after it is mixed.

Q. If your dust agglomerates, what effect does it have on the test data?

A. If any dust agglomerates, it depends on how

(Testimony of Frank B. Rowley.)

much it will agglomerate. All fine dust will agglomerate. It is very difficult to keep it from doing so.

Q. In your testing, using your dusts that you have tested, as compared to the dust that the Farr Company uses, haven't you experienced the same type of thing that I have been calling your attention to on Exhibit JJ, that you have to try to draw a curve by some kind of an average of points that are quite far distant removed from the curve?

A. No. That has no relation to the difference in dust. I have not used the road dust or Arizona dust that Farr is using.

The Court: Now it is the Duncan dust.

The Witness: The Duncan dust.

By Mr. Leonard S. Lyon:

Q. As a matter of fact, it has been your experience, in your own testing work, that you have these points quite substantially removed from the curve, and they are not close to the curve you have actually drawn, you have to average them, is that correct? [753]

A. It is our experience, in testing any of this kind of apparatus and rating it, that you cannot get curves to fall right on the lines, and we plot our curves from the points which we get and we put the points down to show what data we have used in plotting the curves.

Q. Just one question on this point. We furnished you with the actual rating, measurements, that Mr. Duncan found and upon which he based his

(Testimony of Frank B. Rowley.)

curves. Did you examine those? A. Yes.

Q. Did you notice that the actual readings correspond very closely with the values on the curve that he drew? A. Yes, I did.

Q. Much closer than your work, isn't that correct? A. Yes. [754]

* * * * *

Mr. Baldwin: It appears to the defendants that the procedure is developing into a battle of test procedures and we think that is immaterial to the issues in the case, and if it will hasten the trial at all we are willing to stipulate that the Farr Company has very fine test apparatus, that Professor Duncan gets accurate results with it, and that the Farr Company test procedure for the purposes of this action is the best in the world.

Mr. Leonard S. Lyon: I will accept the stipulation and I will try to shorten the case as much as I can in view of it. [755]

* * * * *

By Mr. Leonard S. Lyon:

Q. I believe you testified that you thought the dust employed by the Farr Company in its testing procedures would give a lower pressure drop because that dust had a heavier density than the dust you employed in your test. Is that what you meant to say?

A. Well, it is a heavier density, yes. It is not a mixed dust, it is a single dust, but of a heavier density.

Q. Your knowledge of the density of the Farr

(Testimony of Frank B. Rowley.)
dust is confined to the figure that was given you by the plaintiff, to wit, a density of 2.5?

A. I don't have the density nor figures on the Farr dust, no.

Q. What did you think it was in expressing your opinion?

A. I don't know. I haven't worked with the dust. I don't know the density.

The Court: Excuse me, counsel.

I might say this in connection with these tests: I notice by Plaintiff's Exhibit 13 that both the Farr device and the Air-Maze device were tested under identical conditions with the identical dust. It does not seem to be the case with the test results—well, that is not correct.

The test results of the defendants were made under [757] identical conditions with identical dust, but I do not have before me any test results of the Farr device made by the plaintiffs under the defendants' dust or any of the defendants' tests made with the Duncan dust.

Mr. Harris: There are none.

The Court: I know there are none. But I have to decide this by weighing dust here.

By Mr. Leonard S. Lyon:

Q. What did you base your opinion on that the plaintiff's dust would give a lower pressure drop than the dust you employed if it was based on a comparison of their density and you didn't know what the density of the plaintiff's dust was?

A. Well, it is a dust, a single dust, it isn't a

(Testimony of Frank B. Rowley.)

mixed dust, for one thing. And then the density was given as 2.5, and I know it would be a jolted density from the figure. It would be heavier than the dust I used but I don't know what the jolted density is. I never tested it.

Q. Did you understand that that figure of 2.5 was the actual specific gravity of the dust and not a jolted density?

A. I knew that the jolted density wouldn't be up there. I didn't know what the 2.5 was. I thought it was a pretty high figure.

Q. Well, will you explain to the Court what is meant by a jolted density, if you know? [758]

A. A jolted density is the density of the mixed dust at maximum density when it is jolted.

You take the sample dust and put it in a container and then that is loose dust, and that density is lower than it is when you jolt it down. You jolt it until you get the smallest volume that that dust can contain.

The Court: You do not pack it?

The Witness: No, just jolt it.

The Court: You do not force it, you just jolt it?

The Witness: You jolt it and you will soon strike a maximum density, and that is what we call the jolted density.

By Mr. Leonard S. Lyon:

Q. Is the jolted density the same value as the specific gravity?

A. Well, the specific gravity—I think you are

(Testimony of Frank B. Rowley.)

confusing the terms there—the specific gravity is often called the jolted density, the same as the jolted density is called the specific gravity. The specific gravity is the weight per unit volume and of course the jolted density we give that in grams per cubic centimeter. [759]

By Mr. Leonard S. Lyon:

Q. Well, what do you understand is the specific gravity of the plaintiff's dust?

A. I don't know as I just understand what they did mean by that figure. It was much heavier than what I would suppose our dust—than I know our dust to be, but I don't know just exactly what they were. I think they should explain what they mean by it.

The Court: Have you ever seen any Duncan dust?

The Witness: I have seen it, but I have never worked with it. I have seen the dust.

By Mr. Leonard S. Lyon:

Q. Have you determined the specific gravity of the dust that you have employed?

A. Well, I have determined the jolted density, and that is what we use.

Q. Well, have you determined the specific gravity?

A. The specific gravity of the dust as a whole, yes, that is, the jolted density, that is the weight per unit volume, and that is specific gravity.

Q. How would you measure the specific gravity

(Testimony of Frank B. Rowley.)

of a dust such as we are talking about, to determine its actual specific gravity?

A. If I was determining the specific gravity, that is, the weight of the dust per unit volume, which is termed the [760] specific gravity, I would take a volume of that dust and measure that volume in a jolted density condition, and I would have the specific gravity in weight of the dust per unit volume.

Q. That would be actually what is known as the parent density of the dust, would it not?

A. No. We call that the jolted density of the dust.

Q. I am not interested in what you call these things. A. Well, that is the term.

Q. What I am trying to find out—there is a scientific method for determining specific gravity, isn't there?

A. It depends on whether you are talking about the specific gravity, about the dust volume, or whether you are talking about the specific gravity of the particles of which the dust is made.

Now, when you jolt the dust down, you have some of the air jolted out of it, and that is what we call the density of the dust.

Q. Would the opinion that you have expressed be any different if you knew that the figure 2.5 that was supplied by the plaintiff represented actual specific gravity as determined scientifically and not mere jolted density?

A. No, because I would be quite certain that

(Testimony of Frank B. Rowley.)

that dust was much heavier than what I used, even with that specfic gravity. [761]

Q. Have you determined the specific gravity of the dust that you used? A. No, sir.

Q. Other than by the jolted density method?

A. No, sir, I haven't.

The Court: Well, what is the jolted density per unit volume of your dust?

The Witness: .55.

The Witness: .55.

The Witness: Yes.

The Court: That is the specific gravity?

The Witness: That is the specific gravity in terms of weight per unit volume. But, now, they are talking about the specific gravity of the dust without any air in it at all. There is always some air in that volume after jolting.

By Mr. Leonard S. Lyon:

Q. How would you determine the latter?

A. Well, you have to immerse it in water and get the water displacement of the solid particles.

Q. And do you know whether that figure would be the same as the figure that you gave for jolted density? A. No. It would not.

Q. It would not?

A. It would not be the same.

Q. Would it be greater or less? [762]

A. It would be greater, because the air is taken out on that determination.

The Court: When you say .55 per unit volume, what is the unit?

(Testimony of Frank B. Rowley.)

The Witness: Well, it is .55 gram per cubic centimeter.

The Court: Per cubic centimeter?

The Witness: Yes, that is right.

The Court: And that "per cubic centimeter" is unit volume?

The Witness: That is unit volume, and the specific gravity of water on that basis is 1, so ours is .55 of the weight of water per unit volume.

By Mr. Leonard S. Lyon:

Q. Have you examined or are you familiar with Plaintiff's Exhibit No. 4, the Air-Maze P-5 bulletin?

A. Well, I have seen it. I haven't examined it closely.

Mr. Leonard S. Lyon: May we have it, Mr. Clerk?

(The clerk hands document to the witness.)

By Mr. Leonard S. Lyon:

Q. Will you look at the first inside cover page, the paragraph at the bottom of the page in the first column, which starts out, "Because of its remarkable efficiency at high velocity." Do both Exhibit HH and Plaintiff's Exhibit 13 show that the Air-Maze P-5 filter involved in this case has high filtering efficiencies?

A. No. They are not high filtering efficiencies, not [763] in terms of dust taken out, no.

Q. Well, they both have approximately the same efficiency, do they not?

(Testimony of Frank B. Rowley.)

A. They both have substantially the same. They are a little different in the range throughout the test.

The Court: When you say that they do not have a high efficiency, of course "high" is a comparative term—high compared to what?

The Witness: Well, compared to the scale percentages. The high-efficiency filter, I would say, would be in the 90's or above, in arrestance. The efficiency based on dust taken out is only up to about 75.

The Court: 75 per cent or whatever it is?

The Witness: About three-quarters.

Now, in fact, in the efficiency of filtering air, it is much easier to take out that first dust, it doesn't take too much filter to take out 40 and 50 per cent, but as you go up in percentage it becomes very much harder, when you get into a rather high efficiency you experience that, when you get to 90.

The Court: Are you familiar with the commercial demand, that is to say, whether or not the commercial demand is for a filter which will go beyond the range of these two filters in efficiency?

The Witness: Some of the commercial demand. [764]

The Court: The ordinary commercial demand?

The Witness: Lots of it is, yes. Both ways. In some places the commercial demand doesn't require it and at other places it does require it. There are some places that require a very high

(Testimony of Frank B. Rowley.)

efficiency, and these filters wouldn't be adapted to it.

The Court: That is, by "adapted," you mean to the ordinary use such as of a food store or home?

The Witness: Yes, I think they would.

The Court: Or an ordinary commercial establishment?

The Witness: Yes.

The Court: Like a department store?

The Witness: Yes, I think they would.

The Court: Just like that?

The Witness: Yes.

The Court: Or a railroad car?

The Witness: Yes, in railroad cars. It depends on how they are used in railroad cars.

The Court: Well, I mean for the passengers.

The Witness: Yes.

The Court: Where they are.

The Witness: Yes.

The Court: In warehouses?

The Witness: Yes.

The Court: And generally? [765]

The Witness: In general.

The Court: The higher rate of efficiencies would be for some special purpose, such as filtering out all of the dust particles in connection with some explosive medium, such as gasoline, Diesel fuel, or some other, or at a hospital?

The Witness: I wouldn't go clear to that range for high efficiencies. There are many cases, I think,

(Testimony of Frank B. Rowley.)

where you want a higher efficiency than the 75 per cent. If you have a certain fine dust in there that is going to discolor the room walls and places, where you want that fine dust taken out, then you have got to have higher efficiencies.

* * * * *

By Mr. Leonard S. Lyon:

Q. Well, the phrase used in Exhibit 4 by the defendant is "remarkable efficiency." Do these Exhibits HH and 13 reveal that the P-5 filter has a remarkable filter efficiency?

A. Well, I think that term "remarkable" is relative, and if they want to call their efficiency remarkable, I think that is permissible. I think it is something that different people would give a different value to.

Q. Would you say there is anything remarkable about [766] the defendants' P-5 filter in its filter efficiency?

A. Well, I think it has a good average efficiency, with a low resistance, a good filter.

Q. You think it is remarkable in that sense?

A. No, I don't know that I think it is remarkable in that sense.

The Court: You think this might be a little poetic license or a salesman's puffing?

The Witness: I think a great many of these curves are salesman's license, that you are getting.

By Mr. Leonard S. Lyon:

Q. Now, continuing in the bulletin, Exhibit 4, the next reference is to its low static pressure drop.

(Testimony of Frank B. Rowley.)

Do you think that Exhibits HH and 13 both evidence that the Air-Maze P-5 filter has a low pressure drop?

A. I think the pressure drop is relatively low in that filter, yes.

Q. What?

A. Yes, I would say that is a low pressure drop.

Q. And in that sense, do not Exhibits HH and 13 both reveal that the Air-Maze P-5 filter has an efficiency and a pressure drop comparable to that of the patented Farr filter?

A. Well, the pressure drop starts off at about the same in both, but changes as you go up through the loading of the filter, the relation changes. [767]

Q. But within the limits of these tests, are they not very similar?

A. They are similar but not the same. There is a difference indicated in the tests.

Q. And is your answer the same as to the pressure drop?

A. That is what I was talking about, the pressure drop.

Q. I thought you were talking about the filter efficiency.

A. The same applies to both, only in a different manner. There is a difference as you progress with the test between the respective values.

The Court: You mean it has a low static pressure drop compared to that on the chart, your chart on the French patent that you tested?

The Witness: It has a lower one than that and

(Testimony of Frank B. Rowley.)

also lower than some others. The pressure drop in filters varies and it is adjustable. That is, you can change the pressure drop in the design of the filter with the same principle. And these two filters do have low pressure drops.

Mr. Leonard S. Lyon: Exhibit MM is the exhibit you are looking for, your Honor, I think.

The Court: Yes, the clerk has handed it to me.

The pressure drop is the key to the success of a filter?

The Witness: Not necessarily.

The Court: In its continued use, or the key to the [768] longevity of it?

The Witness: It is a key, we would say, to the amount of dust it would hold, but it may not be a key to the success of it because usually a filter with a high pressure drop, the same design, will have a higher efficiency.

If you want high efficiency then you must sacrifice in the pressure drop. You can't very well get a low pressure drop and get up into the high efficiency.

The Court: Assume a filter would run between 70 and 80 efficiency, to begin with. The longer you can keep the pressure uniform, why the longer that filter can remain in use?

The Witness: That is true, provided it is doing the work.

The Court: Assume that it is.

The Witness: If it is efficient.

The Court: Assume that it maintains within the

(Testimony of Frank B. Rowley.)

range as shown by the various charts, within the range of the P-5 and the Farr filters ?

The Witness: That is correct.

By Mr. Leonard S. Lyon:

Q. Now you have stated that the third factor of significance in the performance of these filters and the type we are now inquiring about, is its flow rate.

Have you made any tests to determine the comparative flow rates for which the P-5 filter and the Farr patented filter are adapted? [769]

A. Well, if I understand your question, you mean did I have flow rates on those filters?

Q. Yes.

A. No, the tests I made was 300 feet per minute on the filters, both of them.

Q. You made no other tests?

A. I didn't make any high velocity tests.

Q. You don't know whether they are both adapted for higher velocity flow rates or not?

A. No, not from my tests.

Q. Well, now, the third and next statement in the defendant Air-Maze catalog with reference to the P-5 filter—I am referring to Exhibit B—is that it has large dirt holding capacity.

Have you made any tests to determine the comparative dirt holding capacity of the P-5 filter and the plaintiff's patented Farr filter?

A. Well, my curve shows the dirt holding capacities for the various points up to the limit of those tests.

(Testimony of Frank B. Rowley.)

Q. How would you say they compare, substantially the same?

A. Well, they are substantially the same, yes. There is a little difference but not much.

Q. The statement is that that is a large dirt holding capacity. Do you agree that it is a large dirt holding [770] capacity?

A. I think that is the same as the other statements. It depends on who is making the statement and the purpose of its relatively.

Q. You haven't produced any curves for the old style type B Air-Maze filter, have you? Do you know what I am talking about?

A. I suppose it is the one that is in evidence here. I haven't examined it very closely.

Q. I show you Exhibit 5. Did you ever make any filter efficiency and pressure drop tests on that type of filter?

A. Well, I presume that that was in some tests that I made for the Association of Railroads. I don't know whether it was this particular type or not. I don't remember now what the shape of it was or the design.

Q. Along about 1937 you studied and tested the performance of the then typical air filters of the impingement type that was suitable for passenger car service, did you not? A. Yes.

Q. Are those the same tests that you refer to in your testimony on direct examination?

A. That is the same program; yes.

Q. They included tests on the Detroit paper filter or filters of that type, did they not?

(Testimony of Frank B. Rowley.)

A. They included tests on several different types of [771] filters. Manufacturers submitted their filters and those were the tests, and I explained that the filter manufacturers all met and decided on the test dust, and that was the dust used in those tests. It was a mixture.

Q. Those included tests of impingement filters made by the Air-Maze Corporation, is that correct?

A. Yes, I think Air-Maze.

Q. What? A. Yes.

Q. And to the best of your knowledge the type of filter that was then being made and which you tested of the Air-Maze Corporation was like Exhibit 5, was it not?

A. Well, as I say, I don't remember the exact Air-Maze filter design. It was probably of that order. I don't know whether they have changed this design since then or not.

Q. Could you detect any difference in Exhibit 5 from the device that you used?

A. It would be pretty hard to detect what is inside of this filter. You can see the outside wire but what is in inside of there is pretty hard to detect. I don't know what the construction is in this filter.

Q. Can you tell us what type by title or number of Air-Maze filter you tested in 1937?

A. Well, the only thing I know is Air-Maze. I am not sure whether I have a number. I don't know whether I have a [772] type on it or not.

(Testimony of Frank B. Rowley.)

Q. Did Mr. Baldwin have any part in those tests? A. Not that I know of.

Q. I thought maybe he could tell us.

The Court: Which one was it? Could it have been A, B-1, C or D?

The Witness: It is not on that list, your Honor. It is another program.

The Court: It is another test?

The Witness: Yes. This was a program——

The Court: For the railroads?

The Witness: ——for the railroads, as I explained.

The Court: Did you not make any notes on what you tested?

The Witness: I don't have those here. That was in 1937.

I would like to state though that those tests were made, as I explained, at the request of the railroads. The manufacturers and railroad men all met and selected pointly a test dust. Now that dust was composed of a different mixture than any of the dusts we have been talking about here. We had Fuller's earth in it which we didn't have in any of these.

By Mr. Leonard S. Lyon:

Q. That also included a test made on filters made by [773] the American Radiator Company, did it not? A. Yes.

Q. Those were paper filters?

A. Those were paper filters.

Q. Of the throwaway type? A. Yes.

(Testimony of Frank B. Rowley.)

Q. And are those the tests on paper filters which you referred to in your direct examination?

A. No.

Q. Those were different tests?

A. Those tests I referred to in the direct are in this bulletin No. 6, I believe, that was put in evidence.

The Court: I think you did testify that you had conducted some tests for the American Association of Railroads.

The Witness: Maybe I did, but these are different tests. It is the same filters, substantially the same. They were gotten at a different time, however. They were probably the same filters, but it is a different set of tests that he is talking about and it was a different test dust that was used.

By Mr. Leonard S. Lyon:

Q. I show you a document entitled "Report on the Relative Performance of Air Filters," dated January 15, 1938, with the legend, "Mechanical Division, Association of American Railroads, Chicago, Illinois."

(Exhibiting document to counsel.) [774]

By Mr. Leonard S. Lyon:

Q. Did you ever see this report before?

A. Yes, I think so from what you say it is.

Mr. Leonard S. Lyon: I ask that it be marked for identification.

The Clerk: No. 27.

(Testimony of Frank B. Rowley.)

(The report referred to was marked Plaintiff's Exhibit No. 27 for identification.)

Mr. Leonard S. Lyon: On page 4 under the title "Extent of Research Program" in this Exhibit is the following:

"The information contained in this report was obtained from the following sources:

"1. Control laboratory tests conducted under the direction of Professor F. B. Rowley at the University of Minnesota.

"2. Road tests conducted on the Illinois Central diesel electric train, the Green Diamond, operating between St. Louis and Chicago.

"3. A questionnaire which was sent to those railroads that are foremost in passenger car air conditioning."

Q. The Professor F. B. Rowley referred to there is yourself, is it not?

A. Yes, that is correct.

Q. And did you not conduct the tests that are set [775] forth in this report?

A. I conducted the tests that they reported on.

Q. And did you furnish the curves that appear here?

A. I furnished them the test data. I think they drew their own curves.

Q. Did you ever check them?

A. Well, I can't say that I checked them exactly. I made the tests, gave it to them, and they made the curves.

(Testimony of Frank B. Rowley.)

Q. And did you have a chance to see this bulletin before it was published?

A. Not the final bulletin; no.

Q. The data that is in it?

The Court: Was it submitted to you?

The Witness: No, it wasn't. I gave them my tests and they wrote this bulletin.

By Mr. Leonard S. Lyon:

Q. Did you ever read this bulletin before?

A. Yes, I have read it.

Q. Did you ever check to see whether it correctly set forth the results that you obtained and furnished to the railroads?

A. Well, I didn't check the detail, no. I gave them my test results and I assume they wrote them up correctly.

The Court: Did you test the curves?

The Witness: With my data? [776]

The Court: With your data.

The Witness: No.

The Court: To see whether or not the curves were correct?

The Witness: No, I just submitted it to them. They sent them out. I suppose they did, but I didn't check it.

By Mr. Leonard S. Lyon:

Q. Didn't they submit any of this data to you before it was published?

A. No, they took our test data and published it and sent me the copy of it.

(Testimony of Frank B. Rowley.)

However, I am not questioning but what they did it correctly. But I didn't check it.

Q. Following page 16 of this bulletin is a picture showing Fig. 3, Fig. 4 and Fig. 5 over the legend "Air-Maze Corporation."

Did you furnish the railroads with those pictures?

A. I presume I did because I furnished them pictures and I expect these are probably the pictures that we took during and after the tests.

Q. And does that show the filter of Air-Maze Corporation that you tested?

A. This shows the picture of the filter that I tested, yes. That is probably correct.

Q. Can you compare those photographs with Plaintiff's [777] Exhibit 5 and state whether or not apparently Exhibit 5 appeared in those photographs?

A. Well, the part of Exhibit 5 that would appear is this front screen. As I say, I don't know what is back of this screen anymore, whether they have changed their design or not. I just don't know.

The Court: Is that not a picture front and back?

The Witness: These are the pictures before the tests and after the tests, and this is a lint test.

It is all one side. This was the test of the filter as compared to this. (Indicating.)

The Court: Did you take the filter apart to see what was inside?

The Witness: No, not the metal ones.

(Testimony of Frank B. Rowley.)

The Court: Did you set forth in your findings how it was constructed?

The Witness: No, just the Air-Maze filter.

By Mr. Leonard S. Lyon:

Q. At that time had you ever examined the inside of an Air-Maze filter?

A. No, we didn't take the metal filter apart.

Q. I mean at that time. A. No.

Q. Were you familiar with the construction of an Air-Maze filter? [778]

A. Well, excepting that I knew that it was built of metal screen mesh, but I didn't know how many they put in or what the details were, because they submitted the filters through the railroads and we didn't have anything to do with the selection of the filters.

Q. At that time to your knowledge was the Air-Maze Corporation making more than one type of impingement filters using wire screen?

A. I don't know what they were making at the time.

Q. Referring to the next page of this exhibit entitled Figure 6, do you understand that those are curves plotting the results that you obtained in testing the Air-Maze filter, the first curve showing the filter performances and the second curve showing the pressure drop?

A. These were curves which they undoubtedly plotted from my test data that I sent them. I didn't check it. It does show arrestance and resistance, that is true.

(Testimony of Frank B. Rowley.)

Q. Now what does it show the filter efficiency to be?

A. Well, the filter efficiency starts out in that curve about 84 per cent and then it drops down at the end of three and a half hours to probably 79 per cent. It follows fairly closely the 80 per cent line until at the end of 10 hours, then it rises, and from there on it is approximately 85 per cent to the end of 16 hours.

Q. Is that in accordance with the values you actually [779] obtained in your tests?

A. I have explained that, that I sent this test data in and I suppose they plotted it, as far as I know, correctly.

Q. Now referring to the bottom curve, what was the pressure drop across that filter when the filter was clean and the test was started?

A. Well, it is about .18 inches of water. [780]

By Mr. Leonard S. Lyon:

Q. And what was the result there at the end of the test, after 15 hours?

A. After 15 hours it was .38.

The Court: And what does it indicate there?

The Witness: That was a mixture of 50 per cent Pocahontas ash, 20 per cent Eagle Brand lamp black, a different type of lamp black, 10 per cent Fuller's earth, and 10 per cent fly ash. We used Fuller's earth in these tests.

The Court: What is the difference between Pocahontas fly ash and fly ash?

The Witness: Well, I suppose it is all the same.

(Testimony of Frank B. Rowley.)

The only thing is that they don't burn Pocahontas in the furnaces?

The Court: What is Pocahontas?

The Witness: Pocahontas is a special grade, a special type of coal, a smokeless type of coal, used more in residences.

By Mr. Leonard S. Lyon:

Q. What type of oil did you use on the filter, the Air-Maze filter, in that test?

A. This was marked as heavy oil, so I suppose that was a heavy oil, probably a 40 or heavier S.A.E. I don't remember what the term was, heavy or light oil.

Q. On the next page I find another curve sheet with performance curves, the top curve showing the filter efficiencies, and the bottom curve the pressure drop; that is [781] correct, is it not?

A. Yes.

Q. And this curve, which is Fig. 7, states that it is a dust test performance curve for 4-inch, viscous coated, Air-Maze filter, using light oil. What is the difference between this test and the preceding one? Is it that this test used light oil and the other test used heavy oil?

A. That was one difference.

The Court: What is this, a 4-inch filter?

The Witness: This was a 4-inch.

The Court: And the other one was a 2-inch?

The Witness: No. They are both 4-inch filters.

By Mr. Leonard S. Lyon:

(Testimony of Frank B. Rowley.)

Q. Well, they were both the same filter, were they not?

A. I can't say whether they were both the same filter. They were probably both the same design.

Q. Well, they may have been the same filter?

A. They may have been the same filter. I don't know.

Q. Referring to this Fig. 7, will you state to the Court what you found the filter efficiency of that device to be?

A. Well, the arrestance started out at 75. It ran a little above 75 for the first seven hours, and then, from seven to eleven hours, it ran almost exactly 75. Then it began to go up, and at fifteen hours it was 75½, and at [782] twenty hours it was 89.

Q. Now, referring to the curve in Fig. 7 showing the pressure drop that you found in this test, what was the initial pressure drop when the filter was clean?

A. When the filter was clean, the pressure drop was .15, and it ran along at .15 without any apparent changes there for the first eleven hours, and then it began to rise, and at the end of twenty hours was .39.

The Court: Does it show the load there, too?

The Witness: It shows the time in hours.

The Court: But not the load?

The Witness: Not the load, no.

The Court: You don't have the same graph here?

The Witness: No. It is not the same.

(Testimony of Frank B. Rowley.)

The Court: For weight in dust load in filter grams?

The Witness: No.

The Court: That does not show that in either one of those charts?

The Witness: No.

The Court: How fast did you feed it?

The Witness: The rate was slower, as I said, at 20 grams per hour instead of 40.

By Mr. Leonard S. Lyon:

Q. And at what pressure drop flow rate?

A. 300. [783]

The Court: 300.

By Mr. Leonard S. Lyon:

Q. Now, will you compare Plaintiff's Exhibit 11—there is a curve on Plaintiff's Exhibit 11 for the Air-Maze Type B filter efficiency—will you compare that with the filter efficiency curves in Figs. 6 and 7 of this exhibit, Exhibit No. 27, with that curve, and tell me if they are substantially the same, making due allowances for the difference in dust and the difference in test conditions?

A. Well, this filter here is a 4-inch filter? Isn't this a 2-inch filter?

Q. This is a 2-inch.

A. A 2-inch, and this is a 4-inch (indicating)?

The Court: A 2-inch.

The Witness: That is 2-inch.

The Court: That is Type B.

The Witness: That is the one here.

The Court: That is the one in evidence here,

(Testimony of Frank B. Rowley.)

according to the testimony. Exhibit 11 was compared with the Air-Maze Type B, which is Exhibit 5, isn't that correct?

Mr. Leonard S. Lyon: This is a 20 by 20 with a 2-inch thickness.

The Court: Yes. That was the testimony of Professor Duncan.

The Witness: And this is a 4-inch. [784]

By Mr. Leonard S. Lyon:

Q. Oh, these tests, Fig. 6 and Fig 7 of Exhibit 27, were made on an Air-Maze filter which had a size of 20 by 20 with a 4-inch thickness?

A. A 4-inch thickness.

Q. I got the impression that it was 4 inches square.

A. No. It is a 4-inch. They are two different filters altogether.

The Court: I understood the witness' testimony they were a 4-inch filter.

The Witness: This is a 4-inch.

By Mr. Leonard S. Lyon:

Q. Can you answer the question, comparing the curves that I have called your attention to, and making due allowances for the difference in thickness of the filters and the different test conditions and the different dusts, and state whether or not the filter efficiency curves appear to be substantially the same?

A. No, I couldn't do that, because you have two different filters, two different designs, and two dif-

(Testimony of Frank B. Rowley.)
ferent dusts. I don't see how you could compare them. At least I couldn't.

Q. Well, now, can you make a comparison of the pressure drop curves in Figs. 6 and 7 of Exhibit 27 with the pressure drop curve for the Air-Maze Type B filter [785] shown on Exhibit 11?

A. Well, I can compare what you have in these two tests as pressure drop, but they are two different filters with two different thicknesses. The pressure drops aren't comparable.

Q. Well, you would say, would you not, that the pressure drops for the Air-Maze Type B filter, as shown both in your Figs. 6 and 7 of Exhibit 27 and on the curve for the Air-Maze Type shown on Exhibit 11, were both relatively high at the end of the test as compared with the pressure drop that you have covered with reference to the Air-Maze P-5 filter?

The Court: You refer to the Exhibit JJ filter?

Mr. Leonard S. Lyon: Yes.

A. Well, the pressure drop rises faster toward the ends of the tests, in both cases.

By Mr. Leonard S. Lyon:

Q. And goes up to approximately a value of around .4, does it not?

The Court: .5, it says here on Exhibit 11, .5.

Mr. Leonard S. Lyon: Yes, but I think maybe on Exhibit 11 they went a little longer on the test, your Honor.

The Witness: Well, on that one, Exhibit 11, it is up near .5 on the curve. I don't know where this

(Testimony of Frank B. Rowley.)

test stopped because there are no points on this curve to show just what the points are. This curve, on this test we are referring to, [786] Fig. 7 on Exhibit 27, is a little below 4/10 of an inch at the end of the test.

By Mr. Leonard S. Lyon:

Q. Well, you have the term in hours of the test on Figs. 6 and 7?

A. Twenty hours on Fig. 7.

Q. And can you not find on Exhibit 11 on the point on the curve that represents 20 hours?

The Court: Well, it was fed in at the rate of 20 grams per hour, that was his testimony, I believe, wasn't it?

The Witness: Well, he is talking now about this Exhibit 11.

The Court: Yes, I know, but it was fed in at 20 grams an hour.

The Witness: But this is dust load. You have to multiply the feed by the efficiency. It doesn't show on this curve that I can see.

The Court: I guess it wouldn't.

The Witness: You would have to multiply the feed by the efficiency.

The Court: You would have to multiply the feed by the efficiency to get the percentage of the dust obtained.

Mr. Leonard S. Lyon: That is too hard. I will get Mr. Duncan to do that for us.

Q. But am I not correct that you found the Air-Maze [787] filter that you tested in 1937 to

(Testimony of Frank B. Rowley.)

have a marked rise of pressure drop, after the filter had been run for some 12 hours or so?

Mr. Baldwin: I object. The question asks for "a marked rise." I don't believe that is definite.

The Court: Oh, it is cross-examination. Objection overruled.

A. The pressure drop up to 12 hours was practically nothing on this curve. Then it began to go up, and it went up from there to 20 hours, to .39, something like that.

By Mr. Leonard S. Lyon:

Q. Did you ever find a result of that magnitude of pressure drop in any test that you made on the defendants' P-5 filter?

A. I haven't tested his filter up to that rise. This was a 4-inch filter, and I haven't tested the defendants'.

Q. The P-5 filter.

The Court: The Air-Maze.

By Mr. Leonard S. Lyon:

Q. The Air-Maze?

A. No, sir, I haven't gone that far, I haven't tested that far. I haven't carried the test that far in the volume. My tests were on those curves.

The Court: Why did you use the velocity there of 300 feet per minute? [788]

The Witness: That would be standard test velocity that would be used in practically all tests of filters.

(Testimony of Frank B. Rowley.)

The Court: Is it comparable to the ordinary commercial use of installations?

The Witness: Yes.

The Court: Are there any installations where it is higher?

The Witness: Yes.

The Court: As much as 500?

The Witness: Yes.

The Court: Or 2,000?

The Witness: Not in this type of filter. I would say 2,000 is much too high.

The Court: Well, are there velocities where filters are used against air of that velocity?

The Witness: With this type, at 2,000?

The Court: Yes.

The Witness: With this type of filter, if you went up to 2,000, it would take the dust right off the wire, it wouldn't stick, it would take it off from the filters.

The Court: Well, then, the higher velocity, the greater the tendency of the air to blow dust off the filter?

The Witness: That is correct.

The Court: So that, with a lower velocity of air, with [789] the same dust, should show a greater efficiency rating and a higher pressure drop?

The Witness: Providing—it shouldn't necessarily, unless the velocity was high enough to take it off. Now, you might go up to high velocity.

The Court: Well, the difference between 300 feet per minutes and 519 feet per minutes is 219 feet per

(Testimony of Frank B. Rowley.)
minute. Is that a sufficient change in velocity to affect the efficiency?

The Witness: I don't think it would, in taking the dust out, no.

The Court: Or blow it through without giving it a chance to adhere?

The Witness: No, I don't think it would, at 519.

The Court: Would the efficiency of any of these impingement filters be decreased if this viscosity in your material were increased? I don't know what your "S.A.E." means, but in the oil fields they talk about 12 gravity oil, which I know is about asphalt. Would that increase your efficiency?

The Witness: Well, it goes two ways. Sometimes, if you go higher in the viscosity of the oil, you get more efficiency, and at other times you get less. You can't say definitely that you are going to get more or less. Now, with different grades of oil and the same filter, you will get different efficiencies, and you can't always predict, with a change of oil, just which way you are going. It takes [790] some experimental work to determine that.

The Court: Well, suppose you put 12 gravity oil on the Air-Maze P-5 filter, would that collect more dirt than the 40 oil, and assuming all the others the same, the Pocahontas and at 20 grams per minute and at 300 rate of flow.

The Witness: I think a heavier oil, that heavy, would not collect any more dirt. Now, I found with

(Testimony of Frank B. Rowley.)
the P-5 that when I used a 30 instead of a 40, it did collect more dirt on the filter.

The Court: Supposing you dropped it to 20. That is kind of thick?

The Witness: From the tests I made, not going to 20, it might be better than going too low and not getting as good results.

The Court: How do you account for that?

The Witness: Well, the viscosity of the oils, the thickness change, and your velocities, so that your dust particle, as that strikes the oil, it will either stick or be blown off.

The Court: Suppose you reduced the velocity of the air that is coming into this room here now, as it passes through the air conditioner, what effect would that have? I don't know where it is in the ventilating system except I know the intake is in the garage. That was "fine" engineering, for fresh air. Suppose that the velocity of air were [791] reduced to a hundred feet a minute and you had a heavy oil, would that increase the efficiency, that is, the dirt-carrying capacity, or arrestance——

The Witness: No.

The Court: ——as you call it?

The Witness: No. You are talking about the velocity through the filter, and if you increase it up here, the filter is way down there.

The Court: No. Wherever you measure the velocity. I understand you measure your velocity at the face of the filter.

The Witness: That is correct.

(Testimony of Frank B. Rowley.)

The Court: And suppose you reduce it to a hundred feet per minutes and increased the viscosity of the oil, say, to 12 gravity or 14?

The Witness: I think that would probably reduce the efficiency because the particle probably would not strike hard enough to be projected onto the wires.

The Court: It wouldn't strike hard enough to stick?

The Witness: To stick.

The Court: And did I understand you to say that in ordinary commercial installation, such as in this building, that experience shows the velocity of the air to be about 300 feet per minute?

The Witness: That is through the filter. [792]

The Court: That is at the face of the filter?

The Witness: That is right. Up in here, the velocity is higher than that.

The Court: Yes, here at this end.

The Witness: Yes.

The Court: It is blown out of a smaller hole, and sometimes it gives me a pain in the neck.

The Witness: I would think it would.

The Court: Well, in an ordinary railroad Pullman car, like a sleeper or diner, what is the velocity of air going through the filter?

The Witness: That might be the same as the building, 300 or higher. It used to be, when we tested these filters for a railroad, they stipulated 300 per minute, but of course, on account of the crowded space, they wanted to go higher if they could.

(Testimony of Frank B. Rowley.)

The Court: They don't have a fan sucking the air in?

The Witness: Some of them do, and some of them have a fan——

The Court: Then, with the speed of the train, with the air going through, how is that exposed, face onward or sideways?

The Witness: Sideways. The exposed face is generally so it doesn't affect the flow. If it did, it might affect it either way. [793]

The Court: And you say that is about 300?

The Witness: 300 or above that. They are about that. When we made these tests, 300 was the considered velocity.

The Court: If I understand you, the difference between 300 and 519 is not sufficient to make any difference in the result?

The Witness: Well, probably not much difference in the result, that is correct. I can't say it wouldn't make any difference, but I wouldn't say it would be a material difference, excepting——

The Court: Well, let me see if I understood you correctly. Increasing it from 300 to 519 would not increase it enough so that it would blow the particles through it without adherence, assuming all the others the same?

The Witness: I think that is correct, substantially. There are little differences, but on your point I think they are about the same.

The Court: I haven't any point.

The Witness: The pressure drop through the filter—if you ran the air through that filter at 500,

(Testimony of Frank B. Rowley.)
you would have higher cost in filtering and raise the cost almost double what it is at 300, but it wouldn't in my opinion, change the efficiency or arrestance.

The Court: You have not conducted any experiments at all with your Pocahontas dust at a 519 rate of flow? [794]

The Witness: No.

The Court: Or with any other dust at 519 rate of flow?

The Witness: No.

The Court: Or at any greater flow?

The Witness: Oh, yes, we have run up to 400 on some of our tests.

The Court: I mean greater than 500.

The Witness: Not on these filters.

The Court: With any filters?

The Witness: Not on this type of filter.

The Court: On any impingement type of filter, you have not conducted any experiments where the flow was greater than 519?

The Witness: Well, I do not recollect any. We have run them to get our resistance value, but I don't know whether we have made any research or not. But we haven't on any commercial filter.

The Court: You haven't done any on any commercial filter?

The Witness: No, sir.

By Mr. Leonard S. Lyon:

Q. Did you mean to testify that the reason, in your opinion, that the Air-Maze filter tested, with

(Testimony of Frank B. Rowley.)

the results shown in Figs. 6 and 7 of Exhibit 27, had a pressure drop rise up to approximately .39, was because it was a 4-inch thick filter as compared with the 2-inch filter?

A. No, I don't think I testified to that. [795]

Q. Have you any opinion as to whether a comparable pressure rise would have occurred with a 2-inch thick Air-Maze filter of the same type?

A. Well, it depends on the design of the filter and how the wires are arranged inside, and so forth. If you had a 2-inch filter with exactly the same type that would mean you would spit the filter in two, then I wouldn't expect it to rise.

The Court: In other words, the 4-inch filter has a greater initial pressure.

The Witness: It has more resistance; that is correct.

By Mr. Leonard S. Lyon:

Q. How about a final pressure drop at the end of the test, would it be greater or less in the case of the 2-inch filter than the 4-inch of the same design?

A. Well, it depends on the filter, how it took the dust out and how the dust was distributed through the filter.

Now you can have a 4-inch filter or a 2-inch filter in which the greatest dust catching area is at some section in the filter, and the rise would be very rapid for a small hole.

Other filters spread the dust caught through the filter and then the rise is slower.

(Testimony of Frank B. Rowley.)

But there are differences in design. Some filters will plug up or form high resistance at the entrance, and others someplace back in the filter. It depends on how the filter [796] media is arranged in there and to a certain extent what kind of dust you use in that test.

Q. Can you remember now whether the tests you made with an Air-Maze filter for the railroads included a test with a 2-inch thick Air-Maze filter?

A. I don't recollect. I might have. I don't know whether I did or not.

Q. I show you Figure 8 of Exhibit 27 entitled "Dust Test Performance Curves for 2-inch Viscous Coated Air-Maze Filter Using a Heavy Oil." Did you make such a test?

A. Apparently I did. This is reported here.

Q. And these are the results of that test?

A. These are apparently the ones I sent to them, to the railroad officials.

Q. Now, then, you stated that there would be a difference in the initial drop when the filter was clean, whether it was a 2-inch or a 4-inch filter. Will you compare the initial pressure drop on Figures 7 and 8 and state to the Court if there is any difference?

A. I don't think I stated that the pressure drop would be the same on a 2-inch or a 4-inch filter when it is clean.

Q. I thought you said it would be different.

A. It depends upon the design. Now you may have a 4-inch filter with the same initial pressure

(Testimony of Frank B. Rowley.)
drop as a 2-inch filter. It depends on what material you put in that filter. [797]

Q. Was there any difference in the filters that were tested and reported in Figures 7 and 8 of this Exhibit 27 except one was 4 inches thick and the other was 2 inches thick?

A. I think there must have been a difference.

Q. Do you remember?

A. Well, I didn't look in it. I don't know. They are different filters and I don't know what they are inside.

Q. Do you know if there was any difference between them except one was 2 inches thick and the other was 4 inches thick?

A. Well, I would think from the looks of the resistance curve there must have been a difference because the resistance curve on the 2-inch shows an initial resistance of .15 and I believe that is the same as on the 4-inch.

Q. That is right.

A. So there must have been a difference. They couldn't have been the same design.

Q. What does it show the final pressure drop at the end of the test to be?

The Court: On the 2-inch?

Mr. Leonard S. Lyon: On the 2-inch.

The Witness: On the 2-inch at the end of the test the final pressure drop was .44.

The Court: 144? [798]

The Witness: .44.

* * * * *

(Testimony of Frank B. Rowley.)

The Court: On your Exhibits II, HH, JJ, MM, and KK—that is the defendants' exhibits—I understood you to testify that the dust was the same, the rate of feed was the same and the speed of the air was 300.

The Witness: Yes, sir.

The Court: Now if I understand the answer to the questions which I asked you a few moments ago, these curves would be just the same if the rate of flow had been increased to 500 or 519?

The Witness: Yes, that is correct. The upper curves, the arrestance curves, would be substantially the same. Not the resistance curves, they would have been changed.

The Court: How would they have been changed?

The Witness: The resistance would have been higher. They would have been practically twice as high.

The Court: It would be increased?

The Witness: Yes.

The Court: So it is a tougher test to give it 519 than 300, is that it?

The Witness: It is a higher resistance. It is a greater resistance across the filter when it is going through. [799]

The Court: Then take Plaintiff's Exhibits 11 and 13. You are familiar with these two charts?

The Witness: Yes, I am.

The Court: And if I understand you correctly —let me take Exhibit 13 because Exhibit 11 is different.

(Testimony of Frank B. Rowley.)

Exhibit 13 states that the velocity was 519 feet per minute.

The Witness: That is correct.

The Court: On the Farr type and on the P-5. If I understand you correctly, these lines or curves on this chart would be substantially the same if the flow had been 300 feet per minute?

The Witness: The upper curve, that is correct.

The Court: And the lower curve, what would it have been?

The Witness: That would have been lower on that chart.

The Court: It would have been lower?

The Witness: That is right.

The Court: In other words, the pressure drop would not have increased as much measured in inches?

The Witness: Provided that they used the same dust.

The Court: This says that they used the same dust in both these tests.

The Witness: They used the same test, but not the same dust.

The Court: I understand, but I had understood your [800] testimony to be to the effect that no matter what dust is used that the difference in velocity between 300 feet and 519 feet was not sufficient to affect the efficiency of the filter.

The Witness: That is correct.

The Court: Then do I understand you to say that these curves on Exhibit 13 would be the same if the velocity had been only 300 feet?

(Testimony of Frank B. Rowley.)

The Witness: I think they would have been substantially the same, the upper curves.

The Court: What about the lower curves, would they have been substantially the same?

The Witness: No, it would have been lower.

The Court: Substantially lower?

The Witness: It would have been substantially half. That difference between that and mine is due to the difference in dust, different types of dust.

By Mr. Leonard S. Lyon:

Q. Do you mean by half that the initial pressure would be half and that the final rise would be half, so that the curves just lie on a different elevation on the sheet but would be the same shape of curve, or do you mean to say that there would be a proportionate difference anywhere in the curve?

The Court: From the beginning to the end?

Mr. Leonard S. Lyon: Yes. [801]

The Witness: It would have been substantially half.

By Mr. Leonard S. Lyon:

Q. At the end? A. At the end.

Q. The rise would have been half at the end?

A. That is right.

Q. Or would it be half at the beginning and half at the end?

A. It would be half each place all along the line, just about.

Q. Then it would be substantially the same curve?

A. Substantially the same except it would be lower.

(Testimony of Frank B. Rowley.)

Q. Except it would be lower?

A. But it wouldn't be parallel to that because you drop down more on this end than you would on the other.

The Court: Now on Plaintiff's Exhibit 11, it has the curve here of the Farr device at 519 feet per minute and the Air-Maze Type B device at 346 feet per minute. That is the old Air-Maze Type B.

Do I understand you to say that these curves should be substantially the same if the Farr device had introduced the air at the same rate as the other of 346 instead of 519?

The Witness: I would think it would be substantially the same. I can't say exactly.

* * * * * [802]

By Mr. Leonard S. Lyon:

Q. Exhibit 27 contains the results of tests you made on the American Radiator Company filters for the railroads, does it not?

A. Yes.

Q. Those included paper filters of the throw-away type?

A. That is what they were, yes; paper filters.

Q. And are those the same tests that you referred to on your direct examination that you said you had made with paper filters?

A. No, these aren't the tests reported in there that I referred to.

Q. You didn't produce any curves or test data showing the results of those tests. Can you do so?

(Testimony of Frank B. Rowley.)

A. I think they are in Exhibit 6, the ones I am talking about, pamphlet 6.

Q. Exhibit what?

The Court: In this pamphlet NN?

The Witness: NN, yes.

By Mr. Leonard S. Lyon:

Q. But you have no other curves that you can produce showing the filter efficiency and the pressure drops in those tests? [803]

A. No, I don't have any other here excepting those that I put in evidence.

* * * * *

By Mr. Leonard S. Lyon:

Q. Will you refer to the curves in Exhibit NN and wherever there is a report or a curve showing the initial pressure drop and the final pressure drop in the test made on a paper filter, give us the figures.

A. (Examining exhibit) On filter C, which is the one I think you are referring to, in Figure 4 the initial pressure drop is .15, and the final pressure drop in each of the tests is .32 inches.

The Court: What was the dust load?

The Witness: The dust feed in that filter——

The Court: No, the load at that time.

The Witness: Unfortunately I have to multiply it out. The basis is the dust feed total and for one of the tests it was one type of dust mixture, which was 440 grams, and for the other one it was 560 grams.

Now I would have to multiply those by the effi-

(Testimony of Frank B. Rowley.)

ciency to get the dust holding capacity. It isn't in the curve.

The Court: Very well. [804]

By Mr. Leonard S. Lyon:

Q. Now, then, Figure C shows a rather uniform progression in the increase of the pressure drop, almost a straight line curve, is it not?

A. It curves up a little as it goes out, not exactly a straight line.

Q. But nearly a straight line?

A. Nearly a straight line.

Q. Has that been your uniform observation of what the results you obtain on measuring pressure drop curves with paper filters is?

A. Well, I wouldn't say that all run up to the same. I think it depends on how the dust loads in the filter and the type of dust.

Now sometimes you get a curve that would run flat a little ways and then turn up.

Q. In paper filters?

A. Well, there are several makes of paper filters, of course, several types. And the rise in pressure isn't necessarily a straight line.

Q. Have you in testing paper filters had the experience of having a pressure rise from an initial value of about .15, continued flat for 10 or 12 hours, and then markedly rise in its next few hours to a value of about 1.4 inches?

A. I don't recollect any where I had that condition, [805] no. Sometimes it doesn't rise as fast

(Testimony of Frank B. Rowley.)

but I can't say that I have had them test where they remained flat like that.

Q. Have you had them rise as high as I have indicated, from an initial of 1.5 up to a value of around .4?

A. Yes, I have had them rise up that high, from .15, I think you mean, to 1.4.

Q. Isn't that a type of paper filter?

A. No, it depends on how long you run them.

Q. Has it been your experience generally that paper filters show that?

A. Well, it depends on the rise. It depends on how much dust you put in the filter, how long you run the test, and the various conditions. Of course you can run any test long enough to get that rise.

Q. I show you the page following page 30 in Exhibit 27. There are three pictures, Figure 20 before testing, Figure 21 after dust test and Figure 22 after dust and lint test, over the title "American Radiator Company."

A. Those are evidently tests made for the American Railroads.

The Court: 20x20 in size?

The Witness: Yes.

The Court: How thick?

The Witness: They were substantially 2 inches.

Mr. Leonard S. Lyon: I think it shows here.

The Witness: Well, there was one of them one and three-quarters and the other four inches. I am not sure which one is which in the curves here.

By Mr. Leonard S. Lyon:

(Testimony of Frank B. Rowley.)

Q. Now on page 30 under the legend "Description" the following appears: "Cellular type with large cells on inlet and small cells on outlet. The 4-inch type for combined outside and recirculated air made with four passages viscous loading."

How did those filters compare with those on which you made the tests that are reported in Exhibit NN?

A. Well, those on the Exhibit NN were a different lot of filters. I don't know what the coating was on the cells of either one of them now.

Q. Were they the same filters, same type of filters? A. Same general type.

The Court: That is, large opening and smaller opening at the exit?

The Witness: I am not so sure that they were as large as this. They were larger on the entrance side and smaller on the exit side.

By Mr. Leonard S. Lyon:

Q. How did they compare with——

Do we have Exhibit C here, Mr. Clerk?

(The exhibit referred to was passed to counsel.) [807]

The Court: There are two or three of them. There is another one with smaller holes on the other side.

Mr. Leonard S. Lyon: Exhibit N.

(The exhibit referred to was passed to counsel.)

(Testimony of Frank B. Rowley.)

By Mr. Leonard S. Lyon:

Q. My question is, how did these filters, paper filters, the results of the tests of which appear in Exhibit 27, compare in design with the filter Exhibit N.

A. The principle was the same. I am not sure about the exact details of the sizes.

The Court: Except that one side was large and the other side was smaller?

The Witness: That is right.

The Court: The entrance was larger and the exit was smaller?

The Witness: Yes, that is correct.

By Mr. Leonard S. Lyon:

Q. What would your answer be in a comparison with the filter, Exhibit C?

A. (Examining exhibit) Well, so far as I can see into it, it looks the same.

Q. And would it be the same in making a comparison with Plaintiff's Exhibit 16?

A. (Examining exhibit) Well, I don't know as to the relative sizes of these. There is quite a difference in [808] Exhibit 16 compares with the others, and of course there is differences in the paper, but it was of this general type of construction.

Q. Now referring to the first page after the photographs, I call your attention to a set of curves entited "Figure 23. Dust Test Performance Curves for American Radiator Company Viscous Coated Paper." Are those curves a plot of the data you furnished to the railroads for this report on your

(Testimony of Frank B. Rowley.)

tests on the American Radiator Company paper filters?

A. Well, these are the curves they have plotted, and I assume they took it from those tests.

I noticed you called this viscous coated paper. It is viscous coated filter.

Q. Excuse me.

A. These are the curves purported to be on that type of filter in this report.

Q. These curves show the top curve, the filter efficiency that you obtained on the test with that particular filter?

A. That is correct. It shows the filter arrestance.

Q. And the bottom curve shows the pressure drop?

A. It shows the pressure drop resistance in inches of water; that is correct.

Q. Now can you tell us with what the paper was coated that was present in these filters during this test? [809]

A. No, I don't know what was on them.

Q. Did you put any special coating on it or did it come coated from the filter manufacturer?

A. It came coated from the factory.

Q. Will you read the initial pressure drop as you determined it on that test on that paper filter?

A. The initial drop is .15.

Q. And what was the final pressure drop at the end of 16 hours? A. It is .42.

Q. And was the pressure drop curve substantially flat for the first six hours or so?

(Testimony of Frank B. Rowley.)

A. No, it was rising gradually from the—well, continuously. It curved upward throughout the test.

Q. Was there a change in that curve as you follow the time?

A. No abrupt change, no. It started flat and gradually curved upward.

Q. How much did it rise in the last 2 hours?

A. The last 2 hours?

Q. Yes. A. From .33 to about .42.

Q. How much did it rise in the next to the last 2 hours? A. From .27 up to .33. [810]

Q. How much did it rise in the third from the last 2 hours? A. From .22 up to .27.

Q. How much did it rise in the first 2 hours?

A. From .15—it is just a little under that—up to .16.

Q. How much did it rise in the second 2 hours?

A. About .16 to .17.

Q. Now how much faster was it rising in the last 4 hours than it was in the first 2 hours?

A. Well, between those figures I have just given it was rising faster.

Q. How many times faster? You have testified that it was rising gradually.

A. I would have to get the figures in mind.

The Court: What did it rise in the first 4 hours —what was it, a 16-hour test?

The Witness: Sixteen hours.

The Court: What did it rise in the first 8 hours?

The Witness: The first eight hours it went from .15 to .2.

(Testimony of Frank B. Rowley.)

The Court: That is five-tenths of an inch?

The Witness: Yes—five-hundredths.

The Court: Five-hundredths of an inch?

The Witness: Five-hundredths of an inch. [811]

The Court: Then in the last 8 hours?

The Witness: It was from .2 to .42.

The Court: So that it rose——

The Witness: About a tenth, a little over a tenth.

The Court: ——about four times as much, is that right?

A. The Witness: That is correct.

The Court: In the last 8 hours than it did in the first 8 hours?

The Witness: Yes.

By Mr. Leonard S. Lyon:

Q. Now under the title "Conditions of Test" on page 4 of this exhibit, there is a paragraph No. 1 titled "Test Apparatus. The test conformed with the American Society of Heating and Ventilating Engineers Standard Code and Apparatus for Testing and Rating Air Filters with the following exceptions: (a) The dust feeding apparatus which was developed at the University of Minnesota was substituted for that specified in the code."

Now what was the difference in the dust that you used and that specified in the code?

The Court: He said the dust feeding.

Mr. Leonard S. Lyon: The dust apparatus.

The Witness: The dust feeding apparatus was one that we designed and are using at Minnesota.

(Testimony of Frank B. Rowley.)

The Court: That is the one you had a picture of here? [812]

The Witness: That is the one we had the picture of.

* * * * * [813]

By Mr. Leonard S. Lyon:

Q. Now, it is stated in the next subparagraph (b), "The dust composition was changed in order to be more like that encountered in service. The mixture consisted of:

"1. Pocahontas Ash screened through 200 mesh screen, 50 per cent by weight.

"2. Germantown Lampblack screen through 100 mesh screen, 20 per cent by weight.

"3. Fullers' Earth screened through 100 mesh screen, 10 per cent by weight, and

"4. Fly ash screened through 200 mesh screen, 20 per cent by weight," adding up to a total per cent by weight of 100.

What was the reason for making that change and substitution of dust instead of using the dust specified by the Standard Code?

A. Well, when we started these tests, before we started them, the Association of Railroads called a meeting of all filter manufacturers at Chicago and they had about 20 representatives there of the various manufacturers, and at that meeting we discussed the type of dust, as close as we could get to it, that would represent a railroad dust, and everyone felt that 50 per cent carbon black was too much in the original loading, so they decided to put in

(Testimony of Frank B. Rowley.)

the Fullers' earth, 10 per cent, and 10 per cent fly ash, and then we [813A] had the Eagle Brand carbon black we were using, and that was the first time that that mixture had been used. But after these tests, it was decided that that was not a proper mixture, because it didn't give the filters the adequate chance for life, it shortened the life of practically all the filters.

The Court: You mean that type of dust?

The Witness: That type of dust, yes. That was the first time it had been used.

The Court: For practical use on a railroad, with coal-buring engines, don't you get a lot heavier dust?

The Witness: That is correct, you get heavy dust.

The Court: Cinders?

The Witness: Cinders. And another thing that was not present in this dust is the question of lint which is involved with the dusts.

The Court: You added lint?

The Witness: We added lints in all these tests.

The Court: But you did not get the ordinary service?

The Witness: Well, you did get it. We had so much lint, that was one thing we couldn't——

By Mr. Leonard S. Lyon:

Q. If you will look at Exhibit No. 27, you will find that none of the tests you have reference to carried the lint, that there are tests in here with separate curves where you [814] added the lint, so

(Testimony of Frank B. Rowley.)
maybe you better look at that before you make the statement that in all these tests you had lint present.

A. Wait a minute. I did not mean all the tests. I mean that was a part of the program, and the part we are referring to is the dust tests without the lint.

Q. Just the dust tests without the lint, but all these others, the reports of the lint tests, are in this Exhibit 27, are they not?

A. That is correct.

Q. But the ones I have called your attention to, asked you questions about, there was no lint present in those tests? A. No. That is correct.

Q. What dusts did you use in these tests on Exhibit NN?

A. I will have to look, on the curve.

In the Fig. 4 we used two types of dust. One was Pocahontas ash, between 200 and 325 mesh, and the other was Pocahontas ash screened through 325 mesh screen.

Q. That was a different dust that that which you used for the railroads? A. That is correct.

The Court: A finer dust?

The Witness: There are two type. It was screened. There were two separate dusts there, yes.

By Mr. Leonard S. Lyon: [815]

Q. I believe in discussing the matter of the railroads, you said that the dust you used gave the

(Testimony of Frank B. Rowley.)
filter a shorter life and hence you changed the dust.

A. That is correct. We felt that it gave the filter a shorter life and a higher, quicker rise in resistance, and we felt that it was not an adequate or a proper type of dust, so that is one reason that the research was continued on the types of dust for filters.

Q. Is the purpose of making a test such as you performed for the railroads to show a long life for a filter or to test the filter performance or filter performance characteristics?

A. No. My purpose in any test, in my opinion, is to test the performance of that filter as you expect it on the job, so you will know when you install it what to expect from the filter, and that is the reason why test dust is a very important quesion.

Q. What difference does it make, in performing such a test to determine the filtering performance characteristics of the device, whether it is a long life or a short life?

A. Well, that is a part of the performance characteristics. The length of life of the filter is one of the performance characteristics you are interested in.

Q. Then, the dust that you used for the railroad was the type of dust that would naturally give a low pressure drop, [816] is that right.

A. No. it was not, not necessarily, a low pressure drop.

Q. Well, a lower pressure drop than the dust that was called for by the Standard?

(Testimony of Frank B. Rowley.)

A. Well, no, I wouldn't say that it gives a lower than the Standard dust.

Q. Did you say something about the fact that this——

A. You mean a higher drop, don't you?

Q. What?

A. You mean a higher drop in pressure?

Q. Which would give a higher pressure?

The Court: By a higher pressure, do you mean that the curve goes up faster?

The Witness: I think that is what he means, a higher pressure drop.

The Court: I don't know.

Mr. Leonard S. Lyon: I am not sure that I know. We talk about how fast this curve goes up and we talk about how far it goes up.

The Court: Then, when you say "higher pressure drop" or "lower pressure drop"——

Mr. Leonard S. Lyon: I am not very clear about that myself.

The Court: Well, I am not. [817]

By Mr. Leonard S. Lyon:

Q. Which is the most significant in evaluating the performance characteristics of a filter, the total rise in pressure drop or the rate at which the pressure drop rises?

A. Well, I couldn't say that either one is more significant than the other. It is the difference between the beginning and the end, and if you used one rate, then, of course——

The Court: It is the rate at which its reaches the total, I suppose.

(Testimony of Frank B. Rowley.)

The Witness: That is right, which it reaches at the finish.

By Mr. Leonard S. Lyon:

Q. Are you familiar with the actual requirements of use that these filters have to meet in actual use?

The Court: Which filters? On the railroad filters?

Mr. Leonard S. Lyon: These impingement filters.

The Court: What is that?

Mr. Leonard S. Lyon: These impingement filters.

The Witness: You mean in an ordinary ventilating system?

Mr. Leonard S. Lyon: Yes.

The Witness: Well, I am familiar, yes, with the design conditions.

By Mr. Leonard S. Lyon: [818]

Q. Well, isn't it true that a rapid rise in pressure drop is the thing that must be guarded against, to prevent throwing the system off balance, rather than the final, total rise?

A. No.

Mr. Baldwin: I object. Your Honor, that statement "rapid" again is one of those vague speculations.

Mr. Leonard S. Lyon: I am talking about relatively rapid.

The Court: I think I understand that. The objection is overruled. The witness didn't answer.

(Testimony of Frank B. Rowley.)

The Witness: I said "No."

The Court: What you really mean is the rate of rise.

Mr. Leonard S. Lyon: That is correct, your Honor.

The Witness: It is the difference, the final difference that throws it off.

The Court: It is the final difference?

The Witness: It is the final difference. If you have a system designed that operates on a quarter-inch pressure drop and you put it up to a half, there is a little difference in there. Well, the real difference, of course, is betwen the quarter and the half. The way you get it doesn't of course make much difference.

The Court: If it gets there in an hour, it is worse than if it takes 20 hours, isn't it? [819]

The Witness: Yes. That is the total difference, however.

The Court: It is the total difference, but it is the rate which makes the utility of the filter.

The Witness: It does for the life, yes, that is true.

The Court: The life.

The Witness: Yes. I did not understand the question at first.

By Mr. Leonard S. Lyon:

Q. Following page 4 of Exhibit 27 is table No. 1, entitled, "Comparative Performance Data for Air Filters—Dust Test," and first there is a column headed "Type of Filter," and under that appear

(Testimony of Frank B. Rowley.)

the names "Air Maze," "American Air Filter," "American Radiator Co.," "Annis," Brillo Mfg. Co.," "Burgess," "Independent Air Filter," "Owens Illinois Glass," "Plymouth Cordage," "Safety Car Heating & Lighting," "Universal Air Filter," and "Wilson."

Then the next column is entitled "Thickness, inches"; and the next column is entitled "Initial Resistance, Inches of Water"; and the next column is entitled "Life in Hours"; and next column is entitled "Dust Fed In Grams"; the next title is "Dust Holding Capacity in Grams"; and the next title is "Overall Efficiency in Per Cent"; and then the next title is "Remarks."

Did you furnish that material to the railroads?

A. Well, these are the results from filter tests. [820] They had all these filters, of course.

The Court: Well, you furnished the data?

The Witness: I furnished the data.

The Court: You conducted the experiments?

The Witness: And furnished them the data.

The Court: And furnished them the data, and they made up the tables?

The Witness: That is correct.

The Court: Are those tables correct according to your data?

The Witness: I don't know. I never checked them. I assume they are. I never checked them. They made them up with my data and sent them out.

(Testimony of Frank B. Rowley.)

The Court: Was it ever suggested that they "fudged" a little on it?

The Witness: No.

By Mr. Leonard S. Lyon:

Q. At page 8 of Exhibit 27, under the title of "Summary of Results from Laboratory Tests"——

The Court: What was that last page?

Mr. Leonard S. Lyon: That was Table No. 1, and I was following page 4. Then there are some other tables in here that I have skipped.

Q. There is the title, "Summary of Results from Laboratory Tests," commencing on page 8 of Exhibit 27, where [821] the following appears:

"The criteria by which the performance of the filters may be compared are (a) the life in hours, and (b) the efficiency in per cent.

"Table 1, page 5, shows the performance based upon these factors for the various filters using dust alone.

"Table 2, page 6, shows the performance based upon the same factors using the same dust composition, with the addition of approximately 10 per cent by weight of short wool fibers to represent lint.

"Table 3, page 7, shows the performance of two types of recleanable filters with various viscous coatings.

"The Appendix shows photographs and charts of the individual performance of the various filters based upon laboratory tests. Curves are included for each filter which show:

(Testimony of Frank B. Rowley.)

"(a) Resistance, which is the resistance to air passage interposed by the filter itself.

"(b) Arrestance, which is the percentage relation which the dust concentration to the leeward side of the filter bears to the dust concentration at the same point in the same system when operated [822] under identical conditions, but without the cleaning device. For all practical purposes this may be called efficiency."

Now, as far as I have read, do you agree that those are proper statements of how to evaluate the filters, based on your tests?

A. As to arrestance and dust-holding capacity. Those are the factors you brought up.

The Court: Is that your language there which he read?

The Witness: No. That is their language. They are the writers of the report.

By Mr. Leonard S. Lyon:

Q. Do you think there is something wrong with it.

A. No. That is the way they wrote it up. I did not write that report.

Q. Well, are you content with it?

A. What? Well, I say it is not my language.

The Court: Was it true?

The Witness: What?

The Court: Is it true? Read it. Show it to him. Let him look at it.

The Witness: The first part of it.

(Testimony of Frank B. Rowley.)

The Court: Go ahead and look at it. Take your time.

The Witness: Where did you start on this?

Mr. Leonard S. Lyon: Right on this title, right here [823] (indicating).

The Witness: The first two statements there, "The criteria by which the performance of the filters may be compared are (a) the life in hours, and (b) the efficiency in per cent," I think those are correct.

The next four or five statements are just describing the report, which is satisfactory and correct.

Now, this statement (b) on page 9—yes, that is correct. It is just another way of stating arrestance or efficiency, I think.

The Court: All right, read that.

The Witness: Statement (b) says:

"Arrestance, which is the percentage relation which the dust concentration to the leeward side of the filter bears to the dust concentration at the same point in the same system when operated under identical conditions, but without the cleaning device. For all practical purposes this may be called efficiency."

That is correct.

The Court: What is the leeward side?

The Witness: The leeward is the downstream side.

The Court: And that is a correct statement?

(Testimony of Frank B. Rowley.)

The Witness: That is correct. It is another way of getting efficiency. [824-825]

The Court: All right.

By Mr. Leonard S. Lyon:

Q. The next statement in Exhibit 27 which appears on page 9 is:

"(1) Life in Hours

"The life in hours is the time required for the filter to reach a resistance of .40 inches of water with dust being fed at the rate of 20 grams per hour. The maximum limit of .40 inches of water was chosen because it was found by the air conditioning equipment tests that an external resistance in excess of .40 inches of water caused an excessive reduction in refrigeration capacity."

Is that a correct statement?

A. Well, that is their statement and I assume it is correct. I did not determine that myself. They determined what that maximum resistance should be. I had nothing to do with determining it, but that is evidently a correct determination. They set it up.

The Court: Did you furnish them with all that information in connection with the refrigeration capacity?

The Witness: No. This was taken from the railroad operations.

By Mr. Leonard S. Lyon:

Q. The next statement under this paragraph is headed: [826]

(Testimony of Frank B. Rowley.)

"Overall Efficiency in Per Cent.

"The overall efficiency is that per cent of the total dust fed into the air stream that is retained by the filter."

Is that a correct statement?

A. Yes, that is correct.

The Court: Now, wait. Would you say that when the inches of pressure reaches—what was that, .4?

Mr. Leonard S. Lyon: .4.

The Witness: .4.

The Court: (Continuing) ——.4, from your experience, in testing these filters, that they should be cleaned?

The Witness: I would think that they should be cleaned at .4 or thereabouts.

The Court: Or thereabouts?

The Witness: Yes.

The Court: And that any use of them after that would result in a rapid loss of efficiency?

The Witness: It probably would, because it would probably drop in efficiency and the pressure would probably go up pretty fast.

The Court: I see.

By Mr. Leonard S. Lyon:

Q. Paragraph (3) is entitled "Rating of Filters Based Upon Performance Factor": [827]

"The relative performance of the various filters based upon laboratory data should consider both the life of the filter and its overall efficiency. For all practical purposes, the product of the life in hours and the efficiency in per cent will give a

(Testimony of Frank B. Rowley.)

hypothetical value that may be called the 'performance factor' of the filter. Such a performance factor is a useful method whereby the various filters may be rated according to their performance under laboratory tests."

Do you agree with that statement?

A. Well, that is the general statement covering a method, of course, of getting the performance satisfaction. That is two factors put together, two to determine the one.

The Court: That is, the pressure drop and efficiency rating?

The Witness: That is right, that is the two factors. They multiply them together and call that a factor.

The Court: Then you multiply that to get the final performance?

The Witness: That is right.

By Mr. Leonard S. Lyon:

Q. Then, the final statement, on page 10, (4), says:

"Cost Factor of Filters"

And continues: [828]

"In making a choice of the best and most economical filter to use, there is another factor that must be considered in addition to the life and efficiency. This factor may be called the 'cost factor,' and should consist of three items:

"(a) The initial cost of filter per number of times used, or the initial cost per service period.

"(b) The maintenance cost per service period.

(Testimony of Frank B. Rowley.)

"(c) The additional charge per filter per service period due to the investment in cleaning facilities."

Then follows the "Expressed by formula," and I am not going to read the formula. I will show it to you.

Do you agree with that statement which I have read, under the title, "Cost Factor of Filters"?

A. I think this sums up the cost factor all right —it is one way of summing it up.

Mr. Leonard S. Lyon: Your Honor, it is 4:00 o'clock. I move to adjourn.

The Court: Very well.

Do you expect to make any tests or produce any data of tests on the two filters here that are in suit, where the identical dust is used and the identical rate of flow of air?

Mr. Leonard S. Lyon: I don't know. [829]

The Court: You have done it with the Duncan dust at 519 feet per minute, but you haven't done it with the Duncan dust at 300 feet per minute and you haven't done it with the Pocahontas dust at 519 feet per minute.

Mr. Leonard S. Lyon: We are going to produce some tests that were made back in 1942 or 1943 by the Farr Company for the railroads, which I think the witness will consider comparable to the tests that he made, and they were made on the Farr filter.

The Court: Yes. Well, I am asking merely whether or not you are going to make any tests

(Testimony of Frank B. Rowley.)

here, because, as the matter now resolves itself, I have to make a determination as to whether or not these different dusts are comparable, I have to do the correlating, which could be done perhaps by experiment, between the different dusts at the different speeds.

Mr. Leonard S. Lyon: We will be glad to make any tests that would be helpful to the Court. The only thing is that it is indicated that it takes 20 hours or so for one of these tests.

The Court: Well, you have about 72 hours between now and Tuesday. [830]

* * * * *

Mr. Baldwin: If the Court please, a test was made, according to your Honor's instructions, over the week end out at the Farr Company, and we are having some charts drawn up on the data which Professor Rowley gathered during that test.

The Court: He was present during the test?

Mr. Baldwin: He was present as often as he could be, which was quite a number of times, and we would like to reserve the right, if we finish with Professor Rowley before those charts are available, to have the right to put him on when they are available.

The Court: Before your charts are available?

Mr. Baldwin: Yes, if they finish with him here before our charts are available, we would like to have the right to call him back.

Mr. Leonard S. Lyon: Your Honor, at the adjournment Friday afternoon, having in mind

(Testimony of Frank B. Rowley.)

your Honor's query as to whether any tests could be made to eliminate this problem of correlation, Mr. Duncan and Professor Rowley conferred and agreed upon what they thought would be the best test, which [835] was started on Friday night and which was finished at 8:00 o'clock this morning, and we have reduced the data to the regular form of curves that are being used here.

The Court: Charts, please. I don't like to get "curves" mixed up in a law suit.

Mr. Leonard S. Lyon: Well, Professor Rowley was there and had access to the data, and I think that the best order would be for us, on our rebuttal, to put that test on with Mr. Duncan, if he will produce the curves——

The Court: Charts.

Mr. Leonard S. Lyon: ——and if they find anything wrong with them, of course I have no objection to them, after that, having an opportunity to produce any curve they have.

Mr. Harris: We will have our own curves, in any event, I am sure.

Mr. Leonard S. Lyon: At this time I would like to offer in evidence Plaintiff's Exhibit No. 27 for identification. This is the report of the Association of American Railroads, that I examined the witness on.

Mr. Baldwin: We object, your Honor. It is all hearsay. There has been no evidence adduced as to who prepared it or where it came from. We object.

The Court: The witness testified that he con-

(Testimony of Frank B. Rowley.)

ducted the tests, that he submitted the data, and that he had not only no reason to believe that it was not accurately reported, but [836] had every reason to believe that it was accurately reported. The objection is overruled.

Mr. Baldwin: Those were not his statements, your Honor. He said that the data was not submitted to him and he did not check it.

The Court: That he submitted the data to them.

Mr. Baldwin: That he submitted the data to them, and he doesn't know what they did with it after that. He just said he didn't want to accuse them, the American Railroads, of crookedness, that is all.

The Court: I did not so understand his testimony. I understood him to say that, in effect, he had no reason to doubt that it was accurately reported and that he believed it was. Isn't that correct?

The Witness: Yes. I had no reason to doubt it. As has been stated, it wasn't recorded by me. I sent the tests in and they recorded it and they wrote the report.

The Court: The objection is overruled. It will be admitted in evidence.

(The document referred to, marked Plaintiff's Exhibit No. 27, was received in evidence.)

Mr. Leonard S. Lyon: May I have Exhibit PP?

(The exhibit referred to was passed to counsel.)

(Testimony of Frank B. Rowley.)

Mr. Leonard S. Lyon: Then I would like to have Exhibit 15-B, the plaintiff's exhibit.

(The exhibit referred to was passed to counsel.)

Cross Examination (continued)

By Mr. Leonard S. Lyon:

Q. Referring first to Exhibit PP, what is represented by the holes in this exhibit?

A. The holes in Exhibit PP represent the points of contact between the corrugations that run in opposite directions, the corrugated screens where they contact.

Q. I hand you Exhibit 15-B, and ask you if you can point out to the Court on Exhibit 15-B the points of contact which are represented by the holes on Exhibit PP.

A. Yes. The points of contact on Exhibit 15-B are the points where these screens come together. As we follow through the corrugated section of the top and bottom, they are in contact, and those contact points represent the points where the metal didn't close and represent the holes in here. That is, the solid metal represents these cavities.

The Court: Spaces.

The Witness: Spaces. And the holes are points of contact with the screen.

The Court: Did you drill these holes? [838]

The Witness: No, they were cast and when they were cast in there the metal didn't flow in there, it stopped.

(Testimony of Frank B. Rowley.)

By Mr. Leonard S. Lyon:

Q. Now does not the contact between each one of these points represented by those holes in Exhibit PP divide the structure along the vertical dimension normal to the flow of the air through the filter?

A. No, I wouldn't say those points of contact divide it.

Q. They dissect it, do they not?

A. No, they don't dissect it either.

Q. They extend through it vertically, do they not?

A. It goes through from one to the other.

Q. It goes through from one horizontal subdivision to the adjacent horizontal subdivision, does it not? A. Yes.

Q. And in that sense it bisects vertically the structure, does it not? A. No, it does not.

Q. What does it do?

A. Well, it simply supports one screen on the other. You say dissect. That means divide into two parts.

Q. I mean it forms a solid member extending vertically between the two horizontal members, does it not? A. No, it does not. [839]

Q. It does not? A. No.

The Court: Let me see that.

(The exhibits referred to were passed to the Court.)

The Witness: Not vertically. It is simply point to point.

(Testimony of Frank B. Rowley.)

By Mr. Leonard S. Lyon:

Q. Well, there is a solid metal member, a continuous member formed by the contact at that point, is there not, a vertically continuous member?

A. No.

The Court: It would not be quite vertical, would it? It would go down across that way.

Mr. Leonard S. Lyon: Angular.

The Witness: No, it doesn't run vertically. Actually you have two things supported together at a point.

By Mr. Leonard S. Lyon:

Q. They form a continuous member, do they not?

A. Those points don't form a continuous member.

Q. They form a structure, a vertical structure, around which the air has to flow. It can't flow through that, can it?

A. It can't flow through that point if it is in contact.

Q. And therefore at each one of these holes [840] represented on Exhibit PP there is a metal contact which subdivides the air?

A. Well, there is a metal contact where those screens touch each other.

Q. Yes, and the air has to flow around that.

A. It couldn't flow through the contact point.

Q. That is right.

The Court: Assume that you took—what is that P-5 exhibit, the defendants' number, the 20 x 20 screen?

(Testimony of Frank B. Rowley.)

Mr. Leonard S. Lyon: Exhibit 12, I believe.

(The exhibit referred to was passed to the Court.)

The Court: Assume that you cast that hole 20 x 20 filter with metal such as this one and then you took it out, would these series of holes go right from top to bottom all the way through?

The Witness: The series of contact points and these crossing points with one over the other, one to the next.

The Court: In other words, if you cast that whole thing and were able to take it out you would find these series of holes going from top to bottom?

The Witness: Yes.

The Court: Assume that you cast Exhibit 12, the screen, what is now the screen material, assume that were in solid metal and the places here where there are holes now were free, then you would have an air opening from top to bottom, [841] would you not?

The Witness: No. This lead represents the air opening and the openings in that lead represent where the one layer contacts the other, where the corrugations cross.

The Court: Assume that the screen material in that Exhibit 12 were made out of solid metal, there would not be any way for the air to flow through the screen except through these zigzag openings and it could not go from one layer of metal to the other, could it?

(Testimony of Frank B. Rowley.)

The Witness: No, not from one layer vertically. It goes laterally but not vertically—horizontally.

The Court: You mean it could go from one end of it to the other?

The Witness: Sideways, horizontally, one side to the other.

The Court: Very well.

By Mr. Leonard S. Lyon:

Q. But it would have to divide up into fillets to go from one channel to another because it would have to go around these points of contact that you have indicated, isn't that correct?

A. They wouldn't divide up into fillets, they would just flow across the sheet.

Q. But these points of contact would divide that air in a horizontal flow? [842]

A. They wouldn't, they would have to flow around the points.

Q. That is what I mean. It would have to flow around those contact points and they would divide the air into multiple streams, would they not?

A. No, it would be one stream and each time a stream came into one of those contacts it would flow around. It wouldn't be the same stream.

Q. It would be the same as a screen?

A. What is that? I said stream, the same stream.

Q. But it would be divided by those points of contact?

A. The stream would just flow around it. It would be one stream.

Q. Part of the stream would go around one side

(Testimony of Frank B. Rowley.)

of the contact and part around the other, would it not?

A. Yes, and then when it came to the next contact there would be another part going around.

Q. And the contacts would continuously divide that stream?

A. No, they wouldn't continuously divide the stream.

Q. They wouldn't divide the stream?

A. Not continuously.

Q. Would they divide the stream as the stream reached each contact point of the screen? Would it have to flow around one side and part around the other? [843]

A. That is correct, but it wouldn't divide the stream.

Q. Then, as a matter of fact, the air flow through the screen at the planes shown by Exhibit 15-B is divided both horizontally and vertically into passages, is it not?

I will ask that the question be reread so you will be sure to get it.

(The question referred to was read by the reporter as follows:

("Q. Then, as a matter of fact, the air flow through the screen at the planes shown by Exhibit 15-B is divided both horizontally and vertically into passages, is it not?")

The Witness: No, it isn't.

(Testimony of Frank B. Rowley.)

By Mr. Leonard S. Lyon:

Q. Is it divided both horizontally and vertically? A. No, not divided horizontally.

Q. What do you mean, it is not divided?

A. I mean it is not divided.

Q. Doesn't the air through the P-5 filter in going either horizontally or vertically have to pass around these points of contact and the screen wire?

A. It passes by those points wherever the contacts are.

Q. And they are both vertical and horizontal points of contact, are they not?

A. Well, there are points where the two alternate [844] layers of corrugated material contact.

Q. And whether the air was flowing either horizontally or vertically it would have to pass around the points of contact in the device, is not that right?

A. It would pass around, wherever they come to a point they couldn't flow through the contact.

Q. But the point is, there are such points of contact both vertically and horizontally in the device?

A. Those contacts, as I explained, are just the points where the screen, the corrugation, touches, where one corrugated screen touches the other.

Q. Yes, but there are contacts in the P-5 filter so that the air cannot flow either vertically or horizontally without passing around those points of contact, isn't that right?

A. Yes, but that doesn't mean the stream is divided.

(Testimony of Frank B. Rowley.)

Mr. Leonard S. Lyon: I think that is all, your Honor.

The Court: I would like to ask the witness a question in connection with Exhibit J, which was the path of air flow chart.

The Witness: Yes, your Honor.

The Court: While the path of air flow, if I understand your testimony correctly, is not as illustrated by Exhibit J, but that after the air enters it goes and flows horizontally in each one of these places where they are points, is that [845] correct?

The Witness: No, that is not my testimony as I wanted to state it.

This Exhibit J shows possibilities for the flow of air entering.

The Court: It does not show them all though, does it?

The Witness: It shows only one path, one stream of air entering the filter and shows how that might divide up.

The Court: If I understand your testimony correctly, from this Exhibit PP the air can come in and at the first point of contact and in each one of these it flows horizontally as well as going straight ahead.

The Witness: The point is that it could. There is a path horizontally, not divided. Naturally the air coming in all along here would prevent this spreading in these directions. There are streams of air coming in each one of these entering cells, and

(Testimony of Frank B. Rowley.)

naturally they carry on through the filter and this stream of air, while it has a path and opening through here which isn't subdivided, it will follow this course. What would happen—— [846]

The Court: Each one of these, then, how would they get into the other stream of air?

The Witness: Well, they mix. If we take this stream that is shown here and then come over to the left or right with another stream of air, then there would be a second stream coming, splitting right there (indicating), and this part, the left part of the one I am drawing with the pencil, would mingle with the right-hand part of that stream and form these two down in here and mix.

The Court: Would not this mingle with that and go on down there?

The Witness: That is right, it would go all the way down, it mixes. It goes in and it might go any distance across here (indicating), in the general direction, but it would mingle clear across.

The Court: So it goes across that way and horizontally as well?

The Witness: That is right. There is no subdivision horizontally.

The Court: All right. Redirect.

## Redirect Examination

By Mr. Baldwin:

Q. Professor Rowley, you recall Exhibit LL, which was the French filter, the dirty one?

A. Yes. [847]

(Testimony of Frank B. Rowley.)

Mr. Baldwin: I just want to straighten out one or two things in the record, as we go along.

The Court: All right.

Mr. Baldwin: In the transcript, at page 634, I will read a colloquy between you and the Court. The Court says:

"The Court: That is, seven by seven?

"The Witness: It is actually six by six, inside.

"The Court: Six by six inside?

"The Witness: That is right.

"The Court: You did not fill the outside of that with paraffin?

"The Witness:" ——

This is what it says in the record——

"We did in here, yes, around in here. We did on this window but we did not on the sides."

Q. Is that what you intended?

A. No. That is just the reverse. We filled in around the solid metal part, but not over the window.

The Court: I so understood you at the time.

Mr. Baldwin: The record just happened to be the opposite. The word "not" got in the wrong place.

There is another place in the record, at page 638, which carries over from a series of questions on page 637, in the middle of page 637 is a question respecting Exhibit LL again, and the following question about Exhibit MM, which was the [848] data plotted from the French panel LL. I just want to get him in the right place.

(Testimony of Frank B. Rowley.)

And then you, in response to a question from me: "Does the fact that the resistance rose at the end of 14 hours to .44 inches of water indicate that this filter should be classified as an unsatisfactory filter?

"A. No.

"The Court: What does it indicate?

"The Witness: Well, it indicates the pressure rise.

"The Court: Well, but I mean insofar as its utility is concerned.

"The Witness: Well, it indicates that it is a practical filter, because it has a rather high efficiency, but also we know that, as far as the filter is concerned, we could change the screen in here and put in a little bigger screen and we would have a little greater resistance. You see, we have a very fine screen there."

Q. Is that what you intended to say?

A. No. I intended the reverse. It would be with less resistance with the bigger screen.

The Court: With the bigger screen?

The Witness: Yes. [849]

Mr. Baldwin: There is just one other place which I don't call attention to as being anything incorrect in the record, but beginning at the top of page 639 and down to line 17 of page 640, there was an exchange of questions and answers between the court and the witness, and I will start at the bottom of page 638:

"The Court: Then, when you want to take out

(Testimony of Frank B. Rowley.)

a hundred per cent, you use the spun glass, is that right?

"The Witness: That is one way of getting it out, but that is a very high resistance and you have to change there.

"The Court: Well, it starts out with a high resistance, doesn't it?

"The Witness: Yes.

"The Court: It would have to?

"The Witness: It would have to, to take it out."

Is there any objection, counsel, if the record shows that the colloquy down through line 17, page 640, related to that spun glass filter? I think the record is not clear. That is all. I can read the whole thing.

Mr. Leonard S. Lyon: The record beginning where?

Mr. Baldwin: At the top of page 639.

Mr. Leonard S. Lyon: 639?

Mr. Baldwin: And extending to line 17 of page 640. [850]

Mr. Leonard S. Lyon: I don't know. The Court's question at the top of page 639 says:

"The Court: Well, it starts out with a high resistance, doesn't it?"

And I do not know. If we go back for an antecedent for that, it would appear that the Court is talking about Exhibit LL.

Mr. Baldwin: Well, that is what I want to correct. I can read the whole thing and ask the witness, and I better do it, I guess.

(Testimony of Frank B. Rowley.)

Mr. Leonard S. Lyon: I don't think the witness can construe it. I think that is a matter for the Court, because there is no question but what this is a correct transcript.

Mr. Harris: There is a question of what the witness meant. I think the witness should be straightened out right here and now, if counsel has that impression of the record.

Mr. Leonard S. Lyon: Well, I am not sure that the witness is straightening it out. He may putting a "curve" in it.

Mr. Baldwin: Well, the court was conducting the examination.

The Court: I think that is reverting back to Exhibit LL.

Mr. Leonard S. Lyon: Yes.

The Court: The witness was explaining the Exhibit LL and he said, "Furthermore, the filter will have to be designed to take out dirt, and when you do that you are going to have a higher resistance filter. It is a different construction, [851] a different type.

"The Court: Then, when you want to take out a hundred per cent, you use the spun glass, is that right?

"The Witness: That is one way of getting it out, but that is a very high resistance and you have to change there.

"The Court: Well, it starts out with a high resistance, doesn't it?"

(Testimony of Frank B. Rowley.)

And I am quite sure I was referring to Exhibit LL.

Mr. Baldwin: MM.

The Court: Well, MM, whatever it is. MM is the chart. Here is MM (handing said exhibit to the witness). Wait a minute. Let me see the rest of it now.

By Mr. Baldwin:

Q. Professor Rowley, when the Court asked you, as shown in the transcript near the top of page 639, "Well, it starts out with a high resistance, doesn't it?" referring to Exhibit MM, would you say that that starts out with a high resistance?

A. No. This starts out with a low resistance and builds up, Exhibit MM.

Q. And what were you referring to when you said it starts out with a high resistance?

A. Well, I was referring to those glass filters, those positive, absolute filters, because we have to have a high resistance on those in order to be sure that we are getting all the dirt out with that filter. I was confused with the [852] Court's question, when answering that.

Q. I will read to you a statement from the middle of page 639. This is quoting the witness; the court, first:

"Did you test that on your spun glass filter?" That is line 12.

"The Witness: Not exactly on that basis. We expanded the area. But if you tried to carry the air

(Testimony of Frank B. Rowley.)

through that filter at this 300 feet, it would have a very high pressure drop."

What did you mean when you said "that filter"?

A. I meant the absolute filter.

The Court: The spun glass?

The Witness: The spun glass. If we put that in series with this or used that to take out all of the dust, as a perfect filter, and tried to pass the air through that spun glass, the absolute filter, at 300 feet a minute, it would be a very high pressure drop, is what I was trying to explain there.

By Mr. Baldwin:

Q. And calling your attention to your answer, line 16 on page 639, the witness stating, "It would be impractical for any air-conditioning system, to use that kind of a filter.

"The Court: Because of the high pressure drop?

"The Witness: Because of the high pressure drop and then because of the cost and everything else. [853]

"The Court: You mean the cost of the original installation or the cost of forcing the air through them?

"The Witness: Both."

To what filter were you referring?

A. I was referring to this absolute glass, the positive filter.

The Court: Wouldn't you give the same answer as to this?

The Witness: No.

The Court: You gave a "high pressure drop"

(Testimony of Frank B. Rowley.)

in giving the answer with respect to cost of installation and cost of forcing the air through?

The Witness: It isn't. It is low to start with.

The Court: I know, but it drops at the end of 14 hours. It runs up to .45?

The Witness: Well, but the point is, it could be cleaned any time in here. Then it would be down. This pressure drop is nothing like the pressure drop of that absolute filter that we talk about. It is of entirely different magnitude.

The Court: I see. That is set forth in this American Railroad magazine?

The Witness: No.

The Court: The Owens-Illinois glass filter?

The Witness: No. That is a different type of filter [854] entirely. That is a different type of glass filter. That isn't the positive, absolute filter that is shown in there.

The Court: All right.

By Mr. Baldwin:

Q. I call your attention to the transcript at the top of page 640:

"The Court: You would have to put fans or suction pumps or something in it to get air in it?

"The Witness: You would, or else you would have to have a very large area of the filter if you were going to force the air through with anything like 300 or 500, you would have to have very large fans."

To which filter were you referring.

A. That is the positive filter.

(Testimony of Frank B. Rowley.)

Q. Made of spun glass?

A. Made of fine spun glass that we use for the absolute filter.

Q. I hand you Plaintiff's Exhibit No. 27 and I read to you from the transcript a question you were asked on cross examination, reading from page 786 of the transcript, line 5:

"Q. Well, you would say, would you not, that the pressure drops for the Air-Maze Type B filter, as shown both in your Figs 6 and 7 of Exhibit 27 and on the curve for the Air-Maze Type B shown on Exhibit 11, were both relatively high at the end of the test as [855] compared with the pressure drop that you have covered with reference to the Air-Maze P-5 filter?"

I ask you to examine Exhibit 27 and state what type of Air-Maze filter was involved in the tests of Exhibit 27, if you can find them.

A. Well, the Air-Maze filter involved in Exhibit 27 is described on page 16.

Q. Would you read what it says, please?

A. Reading that description, "Manufacturer: Air-Maze Corporation. Type of Filter: Air-Maze Type A."

Q. I can't find the page number in the record, but at the bottom of page 827 of the transcript you were asked this question:

"Paragraph (3) is entitled 'Rating of Filters Based Upon Performance Factor.'

Can you find that in Exhibit 27? Paragraph (3)?

(Testimony of Frank B. Rowley.)

A. That refers to the exhibit, page 10.

Q. Page 10, you say? [856]

A. It starts on page 9, paragraph (3), based upon the performance factor.

Q. If you were read this statement, perhaps you can follow it in the exhibit (I am quoting from the top of page 828 of the transcript):

"The relative performance of the various filters based upon laboratory data should consider both the life of the filter and its overall efficiency. For all practical purposes, the product of the life in hours and the efficiency in per cent will give a hypothetical value that may be called the 'performance factor' of the filter. Such a performance factor is a useful method whereby the various filters may be rated according to their performance under laboratory tests."

Did you write that language, Professor Rowley?

A. No.

Q. Does that represent a usual criterion for filters? A. No.

The Court: Did it at that time?

The Witness: No. This is the only place I ever saw this quoted, or that performance factor used.

By Mr. Baldwin:

Q. Who got up that performance factor which is mentioned in that paragraph? [857]

A. This was somebody with the Association of American Railroads, in their office. I don't know who got it up. That is, I assume that.

(Testimony of Frank B. Rowley.)

Q. Turn to page 12 of Exhibit 27 and read paragraph (5).

A. Paragraph (5) reads:

"Overall Performance of Filters.

"The overall performance of a filter is based upon the life and efficiency of the filter devided by its cost factor. It is only necessary for a railroad to divide the product of life and efficiency as determined by laboratory tests by the cost factor that is applicable to its own conditions in order to determine the most practical type of filter for its particular service."

Q. What does that mean to you, Professor Rowley?

A. That means you have to take these other two performance factors and consider the cost factor of the filter, the original cost and the operating cost, or whatever enters into the cost of handling that filter. That has to be taken into consideration in order to determine the type of filter that they ought to select.

Q. Who selected the dust for those American Railroad tests that you made in 1937, reported in Exhibit 27?

A. That was a joint selection by the representatives [858] of all the filter manufacturers. There were about 20 representatives that met, and I met with them, in Chicago and we discussed it, and that was the result of that discussion.

Q. Who determined the purpose of the tests and——

(Testimony of Frank B. Rowley.)

The Court: I thought you said the railroads provided some of the dust.

The Witness: I mean the Railroad Association. I want to make that clear. This question now was who selected this type of dust.

The Court: Who selected the dust that was used in the filters. I thought you said on direct examination or cross examination that the railroads selected the dust because they had particular and peculiar conditions.

The Witness: I think that I didn't make myself clear. What I meant was that this group, the railroad officials, the authorities, and the filter manufacturers jointly selected the type of dust. I probably didn't make that clear.

* * * * *

By Mr. Baldwin:

Q. I hand you an exhibit marked for identification as Defendants' Exhibit VV and ask you if you can identify it.

A. Yes, I can [859]

Q. What is it?

A. It is an addition to Plaintiff's Exhibit 13, a photostated copy of Plaintiff's Exhibit 13, and the red lines on that exhibit represent, first the lower curve, which is the pressure rise across the filter in inches of water, and the upper red curve, the curve drawn in red, represents the efficiency. Those curves were taken directly from the test data, part of which I observed over the week end, Friday,

(Testimony of Frank B. Rowley.)

Saturday, Sunday and Monday, and this is the result.

The red graph shows the results of a test which was performed by Professor Duncan or under his direction, his laboratory men, at the Farr plant over the week end.

The Court: On what?

The Witness: On a Farr filter, the same filter that the other data was taken, according to his statement. The only difference between the two sets of curves was the test dust.

Now the red curves were determined by using a dust which was 80 per cent Pocahontas ash and 20 per cent carbon black as selected in their laboratory from some stock they had. Those curves represent the differences that were obtained in these two tests.

The Court: Very well.

By Mr. Baldwin:

Q. And as to the points on the pressure drop curve shown in the red line, how did you obtain that data? [860]

A. I visited the laboratory several times—I was down there six times during the period—and I went over their charts, I talked it over and I actually read many of those points, and they furnished me with the others that I didn't read because they had their laboratory men continuously on the test.

Q. Did you plot that pressure drop curve from the data which you personally read and which they gave you? A. Yes, I did.

(Testimony of Frank B. Rowley.)

Q. And how did you obtain the data for the efficiency curve?

A. The efficiency curve I obtained from their data. Their test apparatus is set up so that the sampling is automatic, and I took their samples and their efficiency figures because I couldn't calibrate those, but I assume they are all right.

Q. I wish you would again enumerate the differences between the conditions under which the curves of Exhibit 13 were plotted for the Farr filter and the conditions under which the red lines were plotted for the same Farr filter.

The Court: I understood him. He said they were identically the same except that he used 80-20 dust.

The Witness: That is correct.

Mr. Baldwin: I beg your pardon.

The Court: That the rate of flow and everything else was [861] the same.

The Witness: Everything was the same, so far as I know.

The Court: Did you conduct any tests there of this standardized fine air cleaner test dust No. 1543094 at the rate of 300 feet per minute on the P-5 filter?

The Witness: No, we haven't done that. We didn't have any facilities for it. The test apparatus was tied up completely for this period.

The Court: Very well.

Mr. Baldwin: I offer Exhibit VV in evidence, your Honor.

The Court: Admitted.

(The document referred to was received in evidence and marked Defendants' Exhibit VV.)

[Printer's Note: Defendants' Exhibit VV is reproduced in Book of Exhibits.]

Mr. Baldwin: That is all.

Mr. Leonard S. Lyon: No questions. [862]

* * * * *

RICHARD EVERETT BROWN

called as a witness by and on behalf of the defendants, having been first duly sworn, was examined and testified as follows:

The Clerk: State your name in full, please.

The Witness: Richard Everett Brown.

The Clerk: And your address?

The Witness: 17108 Invermere Avenue, Cleveland 28, Ohio.

The Clerk: Will you spell that name?

The Witness: I-n-v-e-r-m-e-r-e.

Direct Examination

By Mr. Baldwin:

Q. Will you please state what your education has been, Mr. Brown?

A. I was educated in the public schools in Cleveland, Ohio, and attended Case Institute of Technology in Cleveland, and graduated from there in 1942 with a bachelor of science in mechanical engineering. At the present time I am a registered professional engineer in the state of Ohio.

Q. Would you please state what your work experience has been since you left——

(Testimony of Richard Everett Brown.)

The Court: Registered professional engineer?

The Witness: Yes, sir.

The Court: Out here we have all kinds of engineers. [863] What kind of an engineer are you, a civil engineer?

The Witness: A mechanical engineer.

By Mr. Baldwin:

Q. Will you please state your work experience since you left school?

A. After I graduated from Case I was hired by Air-Maze Corporation and for about the first three years worked in the test and development department as a test and development engineer.

After that time I moved to the product engineering department and in 1948 I was made assistant chief engineer of Air-Maze.

Q. Is that your present position?

A. That is my present position.

Q. Would you state whether or not you have ever tested air filter panels?

A. Yes, I have tested air filter panels. I tested them during the first three years when I was a test and development engineer, and I supervised the testing of all the air filter panels that are tested in our testing development department.

Q. Will you describe briefly the filter panel testing apparatus and procedure that Air-Maze Corporation has?

A. We have several sets of apparatus for different types of test. For viscous impingement type

(Testimony of Richard Everett Brown.)
filters, it [864] would probably be best to start at the air intake end.

The air is drawn first through a positive filter of fiberglass, spun fiberglass, so as to reduce or minimize the possibility of outside dirt upsetting test conditions.

Then the air is drawn through a dirt, automatic dirt, feeder, and then through the 6 x 6 test section of the filter to be tested, and then through the positive filter that is used for determining the efficiency of the filter panel, then thorough a flow controlling valve, then through a flow metering orifice and to a blower. The blower that we use is of very high pressure drop so we can pull all of the air through the various resistances in the system.

When the panels are prepared for test the frames are waxed and——

The Court: Let me follow you. You test a 6 x 6 panel?

The Witness: Yes, sir, 6 x 6 net area, so it is a quarter of a square foot.

The Court: In other words, it is what they call a 7-inch panel?

The Witness: That is right. We wax in half an inch of the enclosing panel.

The Court: And that test panel is set between two absolute filters?

The Witness: The primary purpose for the first——

The Court: Is that what is done? [865]

The Witness: Yes, that is correct.

(Testimony of Richard Everett Brown.)

The Court: Set between an absolute filter at the intake and then one beyond it on the outflow?

The Witness: That is right, with the dirt feeder ahead.

The Court: And the air is introduced by suction?

The Witness: That is correct.

The Court: At the end?

The Witness: That is correct.

The Court: Go ahead.

The Witness: The filter is waxed in the enclosing channel so as to minimize each effect and extra viscous coating running down from this channel onto the media. We are primarily interested in testing a media so that we can compare and reproduce results.

After the panel has been prepared by waxing and dipping in the viscous coating, which in our test work is either S.A.E. 30 or S.A.E. 40 oil, and we make it different on the various types of panels for the class of service in which it will go.

The system is all set up with the positive filter in place. Air is drawn through the system for 10 minutes so as to minimize the humidity effect.

The Court: With the positive filter in place?

The Witness: With the positive filter in place, in the two sections. [866]

The Court: I understand.

The Witness: After the air has been drawn through for 10 minutes the positive filter downstream from the test filter is removed and weighed.

(Testimony of Richard Everett Brown.)
It is weighed on a chemist balance so a very accurate weight can be made.

The filter, this positive filter, is then replaced in the test equipment, the air flow started and then the dirt, the artificial dirt, is introduced into the system.

The weight of dirt being fed into the system is again weighed on a chemist balance so that the weight will be accurate.

The dirt is fed for a 1-hour time period and the pressure drop or resistance readings are taken every 10 minutes.

After the end of the hour the positive filter downstream from the test filter is removed and weighed. All of the dirt that does not reach the test filter is swept from the duct and deducted from the amount of dirt that is figured as being fed into the filter.

For example, if we had 10 grams artificially fed into the filter and 1 gram was in the duct upstream from the filter, we would consider 9 grams as being the amount of dirt fed into the filter.

The efficiency is then determined by a difference in weight of the positive filter before and after the 1-hour dust feed. [867]

The Court: Downstream filter?

The Witness: The downstream filter, that is right.

And divided by the amount of dirt fed into the panel.

(Testimony of Richard Everett Brown.)

By Mr. Baldwin:

Q. How long has this apparatus and procedure been used by Air-Maze Corporation to your own personal knowledge?

A. Well, the equipment as it is now has been, with a few minor exceptions such as an improving the method of feeding the dirt, the same as it was before I got there, before I was hired.

Q. And it has been used in exactly its present condition for how many years?

Mr. Leonard S. Lyon: He can only testify since he has been there.

By Mr. Baldwin:

Q. Of your own knowledge.

A. In its improved condition, the way it is actually now?

Q. Yes.

A. It has been in use now about seven years.

Q. Are you familiar with the Kaiser patent, No. 2,019,186? A. Yes, I am.

Q. Have you ever seen a filter constructed according to this patent? [868]

A. Yes, I have.

Q. Have you ever seen a filter constructed like the Kaiser patent but out of screen mesh materials? A. Yes, I have.

Mr. Baldwin: Will you mark this, please?

The Clerk: Exhibit WW.

(The device referred to was marked Defendants' Exhibit WW for identification.)

By Mr. Baldwin:

Q. I hand you a device marked for identifica-

(Testimony of Richard Everett Brown.)

tion Defendants' Exhibit WW and ask you if you can identify it. A. Yes, I made this myself.

Q. Describe the structure there.

A. Well, it is made up of alternate crimped and flat layers of 14 mesh galvanized screen cloth. It is made up in what we would call two pads, the crimp and flat section on the approach face pad goes diagonally down and the crimp and flat section of the back pad goes diagonally upward relative to a vertical center line. The two pads are separate and space from each other by metal strips.

The Court: Solid metal?

The Witness: Yes, down the edge of the enclosing channel. In other words, each one of these is a separate pad that can be removed individually.

The Court: Let me see it. [869]

(The exhibit referred to was passed to the Court.)

Mr. Baldwin: There is a window on one side, your Honor.

The Court: Yes, and there is a window on this one side. You say metal strips, do you mean screen wire?

The Witness: No, sir.

The Court: Solid metal?

The Witness: Solid metal.

The Court: I cannot see any solid metal.

The Witness: The window comes off, your Honor. It is held on with Scotch tape.

The Court: The solid metal is where? It runs horizontally or vertically?

(Testimony of Richard Everett Brown.)

By Mr. Baldwin:

Q. Is it up in the frame channel?

A. It is up in the frame channel.

You can see it right here, the edge of it right there, your Honor. (Indicating.)

The Court: That is just around the outside.

The Witness: That is right.

The Court: It doesn't go all the way through?

The Witness: No, just down the edge in here.

The Court: I thought you said that it separated each strip. I misunderstood you then.

By Mr. Baldwin:

Q. What is the purpose of that solid metal piece? [870]

A. To make each of these separate pads so that they are all separable.

Q. Is that a spacer?

A. It is a spacer, that is right, to separate the two pads.

The Court: Which is the top of this, the one with the window on the side or where the window is on the top?

The Witness: This would be the top. This is the side. (Indicating.)

The Court: With the glass window on the left side?

The Witness: Yes.

By Mr. Baldwin:

Q. Can we put that in the record as stating that the filter would be used with the glass window vertical is that correct?

(Testimony of Richard Everett Brown.)

A. No, because the approach face would be of this order.

Q. Then the glass window would be vertical?

A. Yes.

The Court: The glass window would be vertical and to the left of the approach side?

The Witness: Yes, sir.

The Court: Very well.

By Mr. Baldwin:

Q. I hand you Defendants' Exhibit N and ask you if you [871] understand what that filter is.

A. It is a Detroit air filter.

Q. Would you state the relationship between the construction of Defendants' Exhibit N and Defendants' Exhibit WW? Is there a relationship between them?

A. Well, the difference is in the material from which it is made. The Detroit air filter is made from paper and the filter in your Honor's hand is made from screen cloth.

The Court: How big are these crimps here compared to the crimps there? These are much smaller crimps, are they not?

The Witness: I would judge that there are about four per inch on that, maybe three per inch, and four per inch on this.

By Mr. Baldwin:

Q. When did you make Exhibit WW?

A. Saturday, December—whatever last Saturday was.

Q. The eighth? A. The eighth.

(Testimony of Richard Everett Brown.)

Mr. Baldwin: Will you mark this, please?

The Clerk: Exhibit XX.

(The device referred to was marked Defendants' Exhibit XX for identification.)

By Mr. Baldwin:

Q. Did you test Exhibit WW?

A. Yes, it was tested in the method I have described, [872] 520 feet a minute using Arizona road dust with a rate of dust feed of 20 grams per hour figured on the basis of a 20x20.

Q. I hand you a paper marked for identification Defendants' Exhibit XX and ask you if you can identify it, if you will.

A. Yes, I can identify this graph. I made the graph.

Q. And what does it show, I mean what is on the graph?

A. It illustrates the dust holding capacity, the pressure drop rise and the efficiency trend. The pressure drop starts at .095 and ends at .14.

The efficiency after the end of the first hour——

The Court: Where is the first hour?

The Witness: The first point on the efficiency curve, which is the dotted curve.

The Court: These?

The Witness: This is the dust holding capacity down here.

The Court: Lines 30, 60, 90, 120——

The Witness: This is the dust holding capacity in grams per square foot of net panel area.

The Court: And the next line is?

(Testimony of Richard Everett Brown.)

The Witness: Dust holding capacity in ounces for a 20x20 panel.

The Court: That is translated?

The Witness: Yes. [873]

The Court: Where are the hours?

The Witness: There are no hours. Each one of these points indicates an hour on the efficiency curve, which is the top dotted curve.

The Court: I see.

The Witness: Each point is an hour's run.

The Court: Very well. Now you said at the end of what hour?

The Witness: At the end of the first hour the efficiency was slightly more than 83 per cent and at the end of the 10 hours the efficiency was slightly more than 88 per cent.

By Mr. Baldwin:

Q. Would you read the pressure drop at the beginning and the end of your test?

A. The pressure drop at the begining was .095 and at the end it was .14 inches of water.

Q. Can you translate—for instance, at the end of the bottom line of data it says 19.9, which you have stated is translated into ounces on a 20x20 panel, is that correct? A. That is correct.

Q. Could you tell the Court what that would be in grams since we have some other curves that are stated to be in grams? [874]

A. There are 453.6 grams per pound. That would be 560 grams at 19.19 ounces.

The Court: 560 grams?

(Testimony of Richard Everett Brown.)

The Witness: Yes, your Honor.

The Court: At the end of the 10 hours, is that right?

The Witness: No, that is at the end of the bottom scale, 19.9.

Mr. Baldwin: I just thought the Court might like a comparison.

I offer Defendants' Exhibit XX in evidence.

I also offer the filter panel WW in evidence, your Honor.

The Court: They are both admitted.

(The devices referred to were received in evidence and marked Defendants' Exhibits XX and WW respectively.)

[Printer's Note: Defendants Exhibit XX is reproduced in Book of Exhibits.]

By Mr. Baldwin:

Q. You stated that you used Arizona road dust as your test dust for the filter WW and as reported in the data on Exhibit XX. What kind of Arizona road dust was that?

A. It is called on the bottle that we buy from AC Division, General Motor Corporation, from either—I think it is Pontiac. It might be Saginaw, Michigan. It is called Arizona Fine Air Cleaner Test Dust. [875] * * * * *

Q. I hand you a copy of Plaintiff's Exhibit No. 8 and call your attention to the page on which appears Graph No. 1, and call your attention to a dust

(Testimony of Richard Everett Brown.)

specification and dust analysis appearing there. Does that properly represent the Arizona road dust which you utilized in testing Exhibit WW?

A. It looks like the same thing.

Q. Have you read, and do you understand, the translation of the French patent to Niestle, No. 739,956?

A. Yes. I have read it, and yes, I do understand it.

Q. Have you ever constructed a filter panel according to the teachings of this French patent?

A. Yes, sir, I have.

Q. When did you construct such a panel?

A. Saturday, December 8th.

The Court: You were busy that day, weren't you?

The Witness: We certainly were.

(A device was marked Defendants' Exhibit YY for identification.)

The Clerk: Exhibit YY.

The Court: That is a seven by seven?

The Witness: Yes, your Honor.

By Mr. Baldwin:

Q. I hand you a filter marked for identification Defendants' Exhibit YY and ask you if you can identify it. [877] A. Yes, I can.

Q. What is it?

A. This is what we call a French P-5. It is the panel made by the teachings of the Niestle patent.

The Court: The French P-5?

(Testimony of Richard Everett Brown.)

The Witness: That is what we call it in the laboratory.

By Mr. Baldwin:

Q. Will you state the nature of the screen mesh material in this Exhibit YY?

A. This is made from 16-mesh bronze screen cloth. There are six layers. Each individual layer has been slotted and slit and expanded so that there are zigzag passages through the filter media.

Q. Did you test that Defendants' Exhibit YY?

A. Yes, I did.

Q. And under what conditions?

A. It was tested at 519 feet a minute with Arizona road dust, A.C. standardized air cleaner test dust, dust fed in at the rate of 20 grams per hours for a 20 by 20 panel.

Q. On what apparatus did you test it?

A. On the apparatus I described previously.

Q. Where?

A. In the Air-Maze Corporation testing laboratories.

Q. And what procedure did you use for the tests?

A. The same procedure that I outlined previously. [878]

Q. I had you a paper marked for identification Defendants' Exhibit ZZ and ask you to identify it, if you can.

(The paper referred to was marked Defendants' Exhibit ZZ for identification.)

(Testimony of Richard Everett Brown.)

A. This is chart of the results of the test run on the Exhibit YY.

The Court: By the way, I notice this has a glass window. Which is up and which is down?

The Witness: In this case, this was (indicating)——

The Court: From the intake or uptake or outflow?

The Witness: This was in the top.

By Mr. Baldwin:

Q. The window was the top?

A. The glass window was the top.

The Court: The glass window was the top and it didn't make any difference which side was the intake?

The Witness: No, sir.

The Court: Which one was the intake in this test?

The Witness: I don't know that I know, unless it is marked on the panel with an arrow. I cannot tell now. It is the same front and back.

The Court: Did you wash this since?

The Witness: Yes.

The Court: You have washed the other one?

The Witness: Yes. The other one was washed.

Mr. Baldwin: I did not wish to contribute any more dirt to the courtroom, your Honor.

The Court: O.K.

By Mr. Baldwin:

Q. Will you read some values from your data on the Exhibit ZZ?

(Testimony of Richard Everett Brown.)

The Court: Wasn't there another one here, that Professor Rowley made and had a chart on?

Mr. Baldwin: That was Exhibit MM.

The Court: The chart, MM. Here it is. All right.

The Witness: The initial pressure drop was .075, and at the end of 10 hours run the pressure drop was .14.

The initial efficiency was 79.5 per cent, and at the end of 10 hours the efficiency was slightly less than 70 per cent.

The curve is on the same form as Exhibit XX.

Mr. Baldwin: Your Honor, I offer in evidence Defendants' Exhibits YY and ZZ.

The Court: Admitted.

> (Said device and document, marked Defendants' Exhibits YY and ZZ, respectively, were received in evidence.)

> [Printer's Note: Defendants' Exhibit ZZ is reproduced in Book of Exhibits.]

* * * * * [880]

Cross Examination

By Mr. Leonard S. Lyon:

Q. What do you mean by your statement that in the tests reported on Exhibits XX and ZZ you used a filter dust-feeding rate corresponding to 20 grams per hour based upon a 20-20 panel?

A. Since the test section is a quarter of a square foot, the rate of feed or the dust concentration is

(Testimony of Richard Everett Brown.)

the same on the six by six section as it would be in a 20 by 20 section.

Q. But, what rate did you actually use?

A. 14.85 grains per thousand cubic feet.

Mr. Leonard S. Lyon: Now, will you hand the witness Exhibit 13, please, Mr. Clerk.

Q. You have stated that the test reported on Exhibit XX was continued for a period of 10 hours. Is that correct? A. That is correct.

Q. At the end of that time, what was the dust load on the filter?

A. Equivalent to 258 grams per square foot.

The Court: I thought you said it was 560 grams.

The Witness: That is for a 20 by 20 panel, your Honor.

The Court: What was it actually on this seven by seven?

The Witness: It would be one-quarter of the 258.

The Court: Of 258?

The Witness: 258 divided by 4. [881]

The Court: 64.5 grams.

By Mr. Leonard S. Lyon:

Q. So, does that mean that compared to Exhibit 13, your test on Exhibit XX continued to a point that corresponds on Exhibit 13 to 541 grams for the dust load on the filter?

A. It would be slightly beyond that, because 541 is 19.9 ounces, and this would be more than that.

Q. Which would be more than that?

(Testimony of Richard Everett Brown.)

A. The dust load on this panel in Exhibit XX would be more than 541 grams.

Q. 19.9 grams per square foot net of panel area indicates the point at which you discontinued your curve, which corresponded to 541, is that right? Oh, you went a little beyond——

A. We went a little beyond.

Q. ——the 19 points? A. That is right.

Q. How much beyond?

A. Whatever 1/10 hour took the total quantity of rate to.

Q. You don't know how much that was?

A. Well, yes. I can figure it out from the exhibit.

Q. I would like to get the total dust load in the test reported in Exhibit XX and find out where on Exhibit 13 there was a comparable dust load in the test reported on [882] Exhibit 13.

A. 585 grams on chart No. 13, on Exhibit 13.

The Court: Where would that be?

The Witness: Well, roughly two lines to the left of the 600.

The Court: I see it.

By Mr. Leonard S. Lyons:

Q. In making the model, Exhibit WW, you stated that you employed 14-mesh screen at whose instruction?

A. We received a phone call on Saturday requesting that a test panel made to the teachings of the Kaiser and Manning and the Niestle patents be made. We made it with the material we had available.

(Testimony of Richard Everett Brown.)

Q. And in the instructions you received over the phone, was there any discussion as to what mesh to use?

A. 14-mesh, 16-mesh, or 18-mesh, because those are the screen cloths that we carry in stock and something that we could make promptly.

Q. Were you told to make them out of screen mesh? A. Yes.

Q. And did you discuss over the phone, with whoever was calling you, what mesh to use?

The Court: He said he was told—oh, excuse me.

A. Well, we were told to make it of a mesh that we have, of either 14, 16, or 18. [883]

By Mr. Leonard S. Lyon:

Q. Going back to Exhibit 13, you state that Exhibit XX was loaded corresponding to 585 grams. That was at the end of 10 or 11 hours?

A. 10 hours.

Q. 10 hours. Now, that load was reached in the test reported on Exhibit 13, in 38 hours, was it not?

A. I don't know.

Mr. Baldwin: I object to that question. There are no hours indicated on Exhibit 13.

Mr. Leonard S. Lyon: Well, you can figure it from Exhibit 13, can you not?

The Court: There are no hours indicated. The objection is overruled.

By Mr. Leonard S. Lyon:

Q. You have the efficiency and you have the feeding rate and you have the total dust load.

A. It could be figured, yes.

Q. Would it take you some time to do it?

(Testimony of Richard Everett Brown.)

The Court: Was it 20 grams an hour?

Mr. Leonard S. Lyon: Yes.

The Court: And by the time it reached 581, you divide 20 into 580, don't you, to get the hours?

Mr. Leonard S. Lyon: It is not as simple as that.

Mr. Harris: It doesn't state 20 grams per hour, your [884] Honor.

Mr. Leonard S. Lyon: You then divide by the efficiency, your Honor.

The Court: It was testified that it was 20 grams an hour.

Mr. Harris: This witness did not so testify. He didn't make this computation.

By Mr. Leonard S. Lyon:

Q. Well, if it was fed at the rate of 20 grams per hour and with the efficiency that appears on Exhibit 13, how long did it take the testing to produce a dust load of 585 grams?

A. 585 grams, at 20 grams an hour?

Q. Yes.

A. At 20 grams an hour?

Q. Yes, with an efficiency as shown on Exhibit 13.

A. Do I average the efficiency or do I take the averages at that particular point, or how do I do it?

The Court: Is that 20 grams per hour per thousand cubic feet?

Mr. S. F. Duncan: 20 grams per hour.

The Court: Regardless of the cubic feet, it is 20 grams an hour?

(Testimony of Richard Everett Brown.)

Mr. S. F. Duncan: It is 20 grams an hour, at the test velocity specified on the exhibit.

Mr. Leonard S. Lyon: 519 feet per minute.

The Court: You had some question about it?

The Witness: Yes. What efficiency should I use for the dirt load?

Mr. Leonard S. Lyon: The efficiency curve shown on Exhibit 13.

The Witness: But which point?

The Court: At 581 grams.

Mr. Leonard S. Lyon: That averages about 76 per cent, so use that figure.

The Witness: All right, 76 per cent. (Making calculation.) A little better than 38 hours.

By Mr. Leonard S. Lyon:

Q. Now returning to the mesh that was used in constructing Exhibit WW, who did you receive the telephone instructions from?

A. Mr. Watterson.

Q. And he told you that he wanted you to take a make a model according to the Kaiser patent but use screen wire, is that right?

A. That is correct.

Q. And what did he say about what size of screen wire to use? A. You mean the mesh?

Q. Yes.

A. He said make it in a mesh that we have available [886] so that the panel could be made and the test run.

Q. Did you tell him what sizes you had available?

(Testimony of Richard Everett Brown.)

A. I think I did at the time.

Q. And what sizes did you have available?

A. 14 mesh, 16 mesh, and 18 mesh.

Q. Why did you select 14 mesh?

A. I don't know that there is an answer to that one. We had a choice of three and we arbitrarily picked one.

Q. The one with the largest holes of the three, is that correct?

A. No, that is not correct.

The Court: Well, it does have the largest holes.

The Witness: It does; that is right.

The Court: Or interstices.

The Witness: Yes.

By Mr. Leonard S. Lyon:

Q. What procedure did you follow in oiling the screen in your test with Exhibit WW?

A. The panel was dipped in SAE 40 oil and allowed to drain for two hours in a warm room. When I say "warm," I mean about 78 degrees.

Then the excess oil was blown or sucked from the filter panel until the weight of the panel closely approximates that of previous tests, the quantity of oil on the panel.

Q. In other words, the oil was removed so that the [887] perforations formed in the screen wire were not clogged with oil, is that correct?

A. No, the purpose for the——

Q. I am not asking for the purpose but as to the fact. Were the perforations open or were they clogged with oil?

(Testimony of Richard Everett Brown.)

A. They were open, as is the case in all panel tests, or most panel tests using that mesh.

Q. Now turning to your tests on this model you made of the Niestle patent, did you receive instructions from Mr. Watterson as to that model?

A. Yes.

Q. What did he tell you to make the model out of? A. Either 14, 16, or 18 mesh.

Q. Wire cloth? A. Wire cloth.

Q. And what mesh did you use?

A. 16 mesh.

Mr. Leonard S. Lyon: Mr. Clerk, will you show the witness Exhibit MM?

(The exhibit referred to was passed to the witness.)

The Court: Why did you use copper there instead of galvanized screen wire?

The Witness: We did not have aluminum or steel screen wire that could be formed to that shape.

The Court: I see.

The Witness: It would have taken a special run of wire to get that.

By Mr. Leonard S. Lyon:

Q. Do you have any knowledge of that test?

A. Yes, I do.

Q. Did you perform that test?

A. No, I did not.

Q. What knowledge do you have of it?

A. I know that I saw, instructed the testing technicians and the men in the laboratory to make

(Testimony of Richard Everett Brown.)
the panel. It was made of 30 mesh. I know that Professor Rowley had been asked to run tests on this specific filter.

Q. And were the tests made in your laboratory?

A. No, they were not.

Q. Have you any opinion as to why the pressure rise on the test shown in Exhibit MM was so markedly different from the pressure rise you report on your Exhibit ZZ?

A. I think there are two reasons. The first reason is the difference in dirt or dust, artificial dust, and the second is probably the opening size in the screen cloth.

Q. Which one is the more important of those two reasons?

A. I don't know that I could break that down.

Q. How was the screen oiled in the test reported on [889] Exhibit ZZ, that is, the screen on Exhibit YY?

A. In the same manner as Exhibit WW.

Q. That is, after being oiled and drained the screen was blown with air so that the perforations were opened up?

A. No, it was sucked. It was put on the blower and the air sucked through the panel.

Q. To open up the perforations?

A. No, to make the quantity of oil on the panel the same as would be on the panel had it been tested with the proper time for drainage.

Q. As a matter of fact, that procedure did open up the perforations, did it not? A. Yes.

(Testimony of Richard Everett Brown.)

Q. Now what oil did you use?

A. SAE 40 oil.

Q. In both cases, both on Exhibit WW and on Exhibit YY? A. That is correct.

Mr. Leonard S. Lyon: That is all. [890]

* * * * *

Richard Everett Brown, recalled as a witness on behalf of the defendants, having been previously duly sworn, testified further as follows:

## Redirect Examination

By Mr. Baldwin:

Q. Mr. Brown, I had you Defendants' Exhibit XX. You were asked, on cross-examination, to make a quick calculation as to the dust feed involved in the data of that chart. I refer you to the legend in the upper left-hand corner of the chart and ask you if you will start with that and explain to the court how you arrive at the proper statement as to the dust feed per hour in that filter.

A. The rate of dust feed conducted in the test was at 14.85 grains per thousand cubic feet.

There are 15.43 grains per gram, which means that there is slightly less than one gram per thousand cubic feet of air.

A 20 by 20 filter, at 520 feet per minute, filters a total volume of 1200 cubic feet of air per minute. In one hour's time that would be 60 times 1200, or 72,000 c.f.m., [893] or 72,000 cubic feet.

At slightly less than one gram per thousand cubic feet would mean that they would have slightly less

(Testimony of Richard Everett Brown.)
than 72 grams per hour dust feed. I said that we fed at the rate of 20 grams per hour, which was incorrect. We fed at the rate noted here on the chart.

The Court: That is 14.85 grams or grains?

The Witness: Grains.

The Court: Grains per thousand cubic feet?

The Witness: Yes, sir.

The Court: Which, translated through this calculation which you have made, means that you fed into the seven-inch filter 72 grams in an hour?

The Witness: No, sir. Rated on a 20 by 20 basis, it would be 72. On the actual six by six section, or seven by seven, there were 7.5 grams per hour gross dust feed.

The Court: Grams?

The Witness: Grams.

The reason we rate in grains is because the American Society of Heating and Ventilating Engineers' guide gives dirt concentrations in grains per thousand cubic feet. So, in some effort to be consistent with a supposed standard for the subject, we have always tried to rate in grains per thousand cubic feet. It confuses the system, "grains" and "grams," but that is the way the "animal" is. [894]

By Mr. Baldwin:

Q. Mr. Brown, you were asked on cross-examination to compare the load on the filter, Exhibit WW, at the end of 10 hours, with the dust load on Plaintiff's Exhibit 13 at the end of approximately 36 or 38 hours. Does what you have said relate to the comparison that you were asked to make there?

A. Yes, it does, because when the amount of dust

(Testimony of Richard Everett Brown.)
that drops from the air, before it gets to the panel, and the amount that passes through the panel, is deducted from the 10 hours times 600, or roughly 72 or a little less than that, it comes out about 69 grams actually for a 20 by 20 filter panel. The amount that drops out and the amount that goes through accounts for the 580 that is actually charted or plotted on the chart, and that is roughly three—well, two and one-half times the 20 grams per hour shown on Exhibit 13—roughly, three times, rather.

Mr. Baldwin: That is all.

Mr. Leonard S. Lyon: No questions.

The Court: Step down.

(Witness excused.)

The Court: The defendants rest again?

Mr. Baldwin: Yes.

(Whereupon the defendants rested their case in chief.) [895]

Mr. Leonard S. Lyon: Exhibits 24, 25 and 26 which have been marked for identification, No. 24 being a Canadian patent, No. 25 being an evaporator patent, and No. 26 being a photo through the evaporator, have not been received in evidence, and I will ask that the three of them be received in evidence.

The Court: Admitted.

(The documents referred to were received in evidence and marked Plaintiff's Exhibits Nos. 24, 25 and 26.)

[Printer's Note: Plaintiff's Exhibit 26 is reproduced in Book of Exhibits.]

* * * * *

Mr. Leonard S. Lyon: The defendant has offered in evidence as Exhibit OO a patent granted to the defendant on the P-5 filter. This is a patent subsequent by many years to the patent in suit.

I would like to offer in evidence at this time a certified copy of the file history of that patent and ask that it be marked Exhibit——

The Clerk: No. 28.

Mr. Leonard S. Lyon: ——No. 28. [896]

(The document referred to was marked Plaintiff's Exhibit No. 28 for identification.)

The Court: It will be received in evidence.

(The document referred to was received in evidence and marked Plaintiff's Exhibit No. 28.)

* * * * *

SYDNEY F. DUNCAN

called as a witness by and on behalf of the plaintiff in rebuttal having been previously duly sworn, was examined and testified as follows: [897]

The Court: You have been sworn before?

The Witness: Yes.

Direct Examination

By Mr. Leonard S. Lyon:

Q. I show you a document entitled test data on Farr Company air filter performed in accordance

(Testimony of Sydney F. Duncan.)

with Association of American Railroads standard test, which I will ask be marked Exhibit 29 for identification.

(The document referred to was marked Plaintiff's Exhibit 29 for identification.)

By Mr. Leonard S. Lyon:

Q. Did you write this document?

A. I may not be responsible for all the words in it, but I was instrumental in producing it.

Q. When was it prepared?

A. Approximately 1942.

The Court: Was it prepared under your supervision?

The Witness: Well, a little better than that—I did a lot of the work on it myself.

By Mr. Leonard S. Lyon:

Q. And you approved it at that time, did you?

A. Yes.

Q. This document contains two sheets of curves. Referring to the first sheet of curves in the document, will you explain what those represent? [898]

A. The sheet labeled R-2 in the corner?

Q. Yes.

A. That curve represents the performance values of three filters plotted on one page. According to the legend at the bottom of the curve, there is a dotted line labeled Brand X filter, 2 inches thick, heavy oil.

There is a solid line which is labeled Farr air filter, 2 inches thick, light oil.

(Testimony of Sydney F. Duncan.)

There is a dash-and-dot line labeled Brand Y filter, 4 inches thick, light oil.

The solid curves on this chart were the ones that I ran using a test dust which was as nearly the same as we could possibly make it as the test dust used in preparing the data for Exhibit 27, which is the Association of American Railroads report on competitive filter performance.

The rate of air flow was 300 feet per minute, as it was in the tests described in Exhibit 27, and the rate of dust fed was 20 grams per hour, the same as the rate described in Exhibit 27.

The curves labeled Brand X and Brand Y, that is, the dotted lines and the dot-and-dash lines are reproduced from data shown in Exhibit 27.

The Court: Let me see Exhibit 27.

(The exhibit referred to was passed to the court.)

The Court: In other words, they are copied from charts [899] that are here?

The Witness: Yes, your Honor.

The Court: What charts?

The Witness: Brand X filter, that is the dotted line, is a copy of the curves shown in Fig. 8 on—I don't know the figure number. Fig. 8 is Brand X filter, which is an Air-Maze filter.

Brand Y is on Fig. 15 of Exhibit 27 and that is an American air filter, 4 inches thick.

Brand X is an Air-Maze filter 2 inches thick.

The Court: Brand Y is Fig. 15?

(Testimony of Sydney F. Duncan.)

The Witness: Fig. 15.

Mr. Leonard S. Lyon: Have you finished?

The Court: I guess he has.

The Witness: I thought perhaps your Honor had a question.

The Court: Go ahead.

The Witness: These curves show that the pressure drop of the Farr filter compared to two other well-known filters existing at that time and tested as nearly as possible under the same conditions of type of dust, rate of dust fed and rate of air flow, that that Farr filter showed a much lower pressure drop and a slower pressure rise.

By Mr. Leonard S. Lyon:

Q. I think Professor Rowley said that the Air-Maze [900] filter that was reported in Exhibit 27 was an Air-Maze A type. Do you know what the Air-Maze A type was?

A. Well, the Air-Maze type A was a filter made according to the teachings of the Greene patent, and I think it is described in Exhibit 27 as having graded screen from front to back starting with about 5/16 mesh on the front and going down to a fine mesh on the back.

Q. What difference was there between the Air-Maze type A filter and the Air-Maze type B filter which is here in evidence as Exhibit 5?

Mr. Harris: May we learn, if the Court please, whether Mr. Duncan has ever seen a type A Air-Maze filter?

The Witness: A long time ago; yes. Not recently.

(Testimony of Sydney F. Duncan.)

The Court: He had not answered Mr. Lyon's question. Do you remember it?

The Witness: The difference was principally that the type A filter had more screen in it than the type B filter.

By Mr. Leonard S. Lyon:

Q. What do you mean by that?

A. There were more layers and more pounds of screen, so to speak, therefore more material in the filter to accumulate dust.

Q. Was the Farr filter that you tested and reported the results of the test in the solid lines curves on Exhibit 29, the filter of the patent here in suit like Exhibit 2? [901]

A. As nearly as slight variations in manufacturing over a period of nine years could make it, yes, packed four layers to the inch, 14 mesh screen.

Q. Does Exhibit 29 on the first page following the title page give the composition of the dust which you employed in that test?

A. Yes, it does, in the table about the middle of the page, which is the same composition as it set forth in Exhibit 27. We made some effort to obtain the same kind of Pocahontas ash and had some difficulty.

Q. Are the values that you plotted on this curve sheet, R-2 of Exhibit 29 for your test with the patented Farr filter, correct as you obtained those values in the test?

A. Yes, they are. There is a difference in the way these curves are plotted and the way some of

(Testimony of Sydney F. Duncan.)

the other curves have been plotted in that the efficiency curve on sheet R-2 of Exhibit 29 is drawn from point to point rather than drawing a smooth line through the general trend of the points as was done in Exhibits 11, 13 and several of the curve exhibits presented by the defendant.

Q. Were these curves for the test with the Farr filter obtained from tests on the same apparatus that Exhibit 13 curves were obtained from?

A. No, this was tested on a variety of the apparatus which preceded this one. Actually it was a vertical test [902] duct so that there was no opportunity for any dust to settle out of the air stream on the floor of the duct. All of the dust fed into the air stream had to reach the filter, which would have assured as high a pressure rise as we could get under the circumstances.

Q. As I understand you, this curve sheet, R-2, in Exhibit 29, is to furnish the court with comparative curves of tests with the Farr filter, the patent in suit, and the old type Air-Maze filter made with the same dust and under the same conditions, is that correct? A. That is correct.

Mr. Leonard S. Lyon: We will ask that Exhibit 29 be received in evidence.

The Court: Admitted.

(The document referred to was received in evidence and marked Plaintiff's Exhibit No. 29.)

[Printer's Note: Plaintiff's Exhibit 29 is reproduced in Book of Exhibits.]

(Testimony of Sydney F. Duncan.)

By Mr. Leonard S. Lyon:

Q. I would like to ask you some questions, Mr. Duncan, about the effect of the use of different dusts in different tests. First, will you tell us why in your present test work you have adopted this so-called Arizona road dust?

A. A comparison of the efficiency values on sheet R-2 of Exhibit 29 and the efficiency of the Farr filter as shown on Exhibits 11 or 13, demonstrates that under the testing procedure used previously we obtained a rather high efficiency. [903] An examination of many of the curves in Exhibit 27 show that filters built in somewhat different fashions but used for approximately the same purpose show a uniform rather high efficiency, and it was discovered by us and others that filters of various designs were sensitive to the particle size of the dust. Using a dust which gave all filters a rather high efficiency made it very difficult to distinguish any preferential efficiency of one filter over another, and so after trying a number of combinations of dust we settled on the so-called standardized fine air clean test dust No. 1543094 as a dust to use because in testing various air cleaning devices in our own laboratory we found that this dust gave a significant difference in efficiency which could be attributed to perhaps difference in the amount of oil or difference in construction or difference in the mesh of the wire and other factors in which we were interested.

A second and very important reason for our choosing the standardized fine air cleaner test dust

(Testimony of Sydney F. Duncan.)

was that it was the only one that we could buy from a reliable source that would be the same from batch to batch or lot to lot and that would be probably the same from year to year because of the rather rigid controls that are exercised in its preparation.

By Mr. Leonard S. Lyon:

Q. Have you found by experience whether or not the screening of a dust through a 325-mesh screen is sufficient classification of the dust particles for test purposes?

A. Well, for my purposes it is not, because putting all of the dust that you are going to use through a 325-mesh screen only assures you that there are not particles larger than would pass through the screen.

It doesn't give any information as to the variation and distribution of that particle's size of the dust that actually goes through the screen. If my recollection serves me right, a 325-mesh screen passes a particle which is about 40 to 44 microns average diameter.

The Court: Would the screen pass dust of smaller microns, smaller than that size?

The Witness: It will pass all dust smaller than 40 or 44 microns.

The Court: What about your dust?

The Witness: In the standardized fine air-cleaner test dust, it is about 40 per cent of the dust, which is about zero to five microns in range.

The Court: What about dust in the air?

The Witness: The particles' sizes range widely,

(Testimony of Sydney F. Duncan.)

from zero up to five and on up. Forty microns is a fairly large particle, and if made of a mineral oxide, as many of our [905] dusts are, the kinds that stir up from the street or are blown up by winds, those particles settle out rather rapidly and so those do no enter into the ventilating system in large quantities.

The Court: In other words, your purpose in getting the measurement of the finer dust is to ascertain whether or not a screen would take out the finer dust? In other words, it is easier to get out the big particles than the small particles?

The Witness: Yes.

By Mr. Leonard S. Lyon:

Q. Have you in your experience found whether or not it is possible to correlate the results of tests made otherwise under similar conditions but using different dusts?

A. Except for a recent endeavor, we haven't made too many tests that would correlate the answers between, for instance, the A.A.R. dust and our present dust.

The Court: "A.A.R." means what?

The Witness: American Association of Railroads (Exhibit 27), containing the Pocahontas ash and lampblack and fly ash and Fuller's earth.

We have tested the same filter with different dusts under otherwise similar conditions and have observed that the efficiency changes. Generally, the efficiency rises with increase in size of particles. The pressure drop characteristic may change with a par-

(Testimony of Sydney F. Duncan.)

ticular kind of dust. Testing with a [906] material which contains fibers of some sort, the pressure drop rises rather rapidly.

By Mr. Leonard S. Lyon:

Q. Then, I take it, if you are going to compare two tests made under otherwise similar conditions, between two filters, they should be made with the same dust, is that correct? A. Yes.

* * * * * [907]

Q. Reference has been made in Professor Rowley's testimony to the jolted density of his Pocahontas type dust as compared with the density of the Arizona dust, and reference has been made to the specific gravity of this Pocahontas dust as compared with the specific gravity of Arizona dust. Will you first state which is material in the test procedure to know, the jolted density or the specific gravity?

A. Well, both of those factors have some effect. However, a clear distinction should be made. When I have spoken of specific gravity, I have referred to the material of which the dust is composed.

When Professor Rowley speaks of jolted density, he carefully explained, I believe, that it was a bulk density obtained by settling down in a graduate a weighed quantity of dust and then measuring its volume.

As the dust in a test set approaches the filter, it has already been through a dispersion process which should have broken it down into its individual particles. To be sure, there may be some of those very

(Testimony of Sydney F. Duncan.)

fine particles which are agglomerated into slightly larger particles, but, in the aspirating system of most of the test sets, in the dust-feeding systems, the dust is picked up from one source and is hit with an air blast which drives it into the air [908] stream entering the test duct, and hitting it with that air blast. Well, the purpose is to break it down into those individual particles, not to break a particle, but just to disperse the particles. If the particle itself is something like volcanic ash or diatomaceous earth—

The Court: Fullers' earth?

The Witness: No—diamotaceous earth. Diamotaceous earth is the skeletons of little animals, little diatoms, and they have a hole in it, so they occupy more space than the solid silica out of which it is made, a particle of that sort would show a large bulk compared to its mass, whereas a particle which was made by grinding up material like cement shows a smaller bulk compared to its mass.

In the case of the dust used by Professor Rowley, as duplicated in our laboratory over the week end, we had some Pocahontas ash and some K-1 carbon black, it was screened according to the procedures outlined by Professor Rowley, and we measured the jolted density of our sample of that dust to see if there was a correlation between that and the dust that he used.

We discovered the jolted density of our dust to be .55, that is .55 grams per cubic centimeter.

A further measurement was made upon the specific gravity of the dust, and it was determined to be 2.4.

(Testimony of Sydney F. Duncan.)

The Court: What was 2.4? [909]

The Witness: The specific gravity of the material of the Rowley dust.

The Court: The material was 2.4, and the dust, when you got it jolted, was .55?

The Witness: Right.

The Court: And the rest of it was air?

The Witness: The rest of it was air.

The standardized fine air-cleaner test dust used—

The Court: You mean the Duncan dust?

The Witness: The Duncan dust. Thank you—has a jolted density of 1.08 and a specific gravity of 2.5. The material then, out of which the two dusts are composed——

The Court: Which would indicate that your Duncan dust has more small particles?

The Witness: And it packs better.

The Court: It packs better?

The Witness: Yes.

The Court: If I understand you correctly, from what you have been saying, without saying so, is that dust composed of large particles will ahere more readily to one of these impingement air cleaners than dust composed of fine particles; in other words, it is easier to catch the big particles than it is the smaller ones.

The Witness: Yes, your Honor, it is.

The Court: And one of the aims and objects of producing [910] an air-cleaning or -filtering system is to get as much dust, regardless of whether it is large or small, as possible?

(Testimony of Sydney F. Duncan.)

The Witness: That is right.

* * * ** [911]

(The document referred to was marked Plaintiff's Exhibit No. 30 for identification.)

By Mr. Leonard S. Lyon:

Q. Will you explain this sheet 30 and what test data it records?

A. On Exhibit No. 30, titled "Replot of 20 by 20 by 2 filter panel test curves," there are shown three curves of efficiency and three curves of pressure drop. One of these curves of efficiency, the dotted line, is a reproduction of the curves shown for the Farr filter on Exhibits 11 and 13. It is the same curve.

The dashed line in both the pressure drop and the efficiency is labeled on Exhibit 30 "Air-Maze P-5 by Rowley, at 300 feet per minute," and is a replot to the scale shown on Exhibit 30. We have "Efficiency per cent" as ordinate and "Dust load on filter, grams" abscissa, a replot of HH.

The Court: What is that?

The Witness: Abscissa.

The Court: I don't know if the reporter got it. I don't know what it means.

The Witness: The efficiency is shown, shall we say, up and down on the chart, and the dust load is shown right [912] and left.

The third curve shown as a solid line is labeled "Farr Type 44 by Rowley at 300 feet per minute"

(Testimony of Sydney F. Duncan.)

and is a replot, I believe, of the curve on Exhibit JJ.

Examining the pressure drop curves for Air-Maze P-5, at 300 feet per minute, and the Farr Type 44 at 300 feet per minute, as plotted from the Rowley data, it is observed that up to 500 grams filter load the points were so close together that I could not draw two lines and I had to draw one.

At about 535 grams load on the filter, a sufficient deviation occurred so that the two lines separate slightly in going from 535 grams out to a little under 700 grams.

The Court: Let me see, now. Wait a minute.

The Air-Maze P-5 type shown on your Exhibit No. 30 is taken from Exhibit HH, is that it?

The Witness: Yes, your Honor.

The Court: And the Farr Type 44, what is this Farr Type 44?

The Witness: That is the patent in suit.

The Court: Oh, by Rowley, taken at 300 feet per minute, and is taken from Exhibit JJ?

The Witness: Yes, your Honor.

The Court: And your Farr Type 44 by Duncan is taken from Exhibit 13?

The Witness: The same curve appears on both Exhibits 11 [913] and 13.

The Court: I see. All right. Excuse me. I interrupted you in the middle of something.

The Witness: It is quite all right.

The efficiency curves as determined by Professor Rowley, when plotted on one piece of paper to the

(Testimony of Sydney F. Duncan.)

scale of dust load on filter, grams, shows that the efficiencies determined by him for the Air-Maze P-5 and the Farr Type 44 show no particularly significant differences.

By Mr. Leonard S. Lyon:

Q. Were those comparisons based on the same flow per minute?

A. These two filters, as tested by Professor Rowley, were both tested at 300 feet per minute, I understand. He used his Rowley dust, and they were, I understand, treated similarly as to oiling procedure.

Q. And using the same dust?

A. Using the same dust.

Q. Now, will you compare the efficiency curve that you obtained, using your dust, at the different rate of 519 feet per minute, with the curves that you have just referred to, that were obtained by Professor Rowley?

A. The dotted curve, shown labeled "Farr Type 44 by Duncan at 519 feet per minute," follows the efficiency curve of the P-5 filter very closely. It drops off perhaps, I think, [914] at 600 grams to about 2 per cent lower, that is, the Farr is about 2 per cent lower than the efficiency found by Professor Rowley for the P-5.

The efficiency for the Farr filter found by Professor Rowley at 300 feet per minute corresponds with reasonable closeness, except for that initial hour or two, to the efficiency found by Duncan at 519 feet per minute.

(Testimony of Sydney F. Duncan.)

The pressure drop found by Duncan at 519 feet per minute is higher than that found by Professor Rowley, as shown on Exhibit 30.

The Court: Did you test the Air-Maze Type B at 519 feet per minute?

The Witness: No, your Honor, I did not.

The Court: Well, is it more difficult to clean the air at 519 feet per minute than it is at 346 feet per minute?

The Witness: Our experience is that efficiency goes up somewhat with velocity. The efficiency increases with this, with an impingement-type filter, where there are many areas on which dirt may collect; the efficiency increases with velocity because of increased turbulence.

The efficiency also increases with particle size, if these are the only two variables.

So that, in my own opinion, the increase in particle size which I have observed under the microscope, on the dust we have prepared in an attempt to duplicate Professor Rowley's [915] dust, the increase of that particle size over that I know to exist in the Arizona road dust increased the efficiency of the Farr filter somewhat increased the efficiency of However, Professor Rowley tested at lower velocity than I did, which should decrease my efficiency. Slightly compensating changes put the efficiencies at just about the same place.

The Court: In other words, the lower velocity increased the precipitation of the heavier dust?

(Testimony of Sydney F. Duncan.)

The Witness: No. The lower velocity would actually decrease the precipitation.

The Court: Of the heavier dust, of the heavy particles?

The Witness: Of almost any dust.

The Court: All right.

By Mr. Leonard S. Lyon:

Q. Referring now to Exhibit No. 30 and comparing the curves between two filters, all made at 300 feet per minute but with different dusts, at that flow rate would you say there is any significant difference in the curves caused by the use of the different dusts?

A. As far as efficiency is concerned, there is no significant difference between the three efficiency curves shown on the chart of Exhibit 30 as on the pressure rise curves there is a significant difference.

Q. Is there a significant difference between the two pressure drop curves for the Air-Maze filter and the Farr [916] Type 44 filter, both obtained at 300 feet per minute.

A. Well, as I said, reading the data as closely as I could from Exhibits HH and JJ, I had to plot just one line for the two filters out to about 535 grams load, and it was only between there and about 680 grams that I could draw two lines at all. So there can't be a significant difference when the follow the same line.

Mr. Leonard S. Lyon: I offer in evidence Exhibit 30, your Honor.

The Court: Admitted.

(Testimony of Sydney F. Duncan.)

(The chart referred to, marked Plaintiff's Exhibit No. 30, was received in evidence.)

[Printer's Note: Plaintiff's Exhibit 30 is reproduced in Book of Exhibits.]

By Mr. Leonard S. Lyon:

Q. You have seen Defendant's Exhibit VV, produced by Dr. Rowley this morning, have you not?

A. Yes. I have looked at it.

Q. Dr. Rowley testified that the red curves on that exhibit were plotted from data that he obtained jointly with you in a test you both observed over the week end. Will you tell the court the purpose of making that test, and outline the test to the court.

A. The test shown on Exhibit VV in the red lines becomes the results of a test which was run on a Farr Type 44 filter at 519 feet per minute in the Farr Company laboratories, using a dust as near a duplicate of Professor Rowley's [917] dust as we could make it, that is, 80 per cent Pocahontas ash screenings through 200-mesh screen, plus 20% K-1 carbon black screened through 100-mesh screen.

Then the two were mixed and were screened through a 100-mesh screen, as dust was fed at the rate of 20 grams per hour. The velocity in the duct, as I said, was 519 feet per minute, and an additional kink was put in the tests, so to speak, in that at intervals the velocity in the duct was reduced to actually about 304 or 305 feet per minute. Because of control limits we could not quite get down to precisely 300. So that, from time to time, as the load

(Testimony of Sydney F. Duncan.)

on the filter built up, we measured the pressure drop across the filter at very close to 300 feet per minute.

The results were computed in the usual fashion, and the red curve of Exhibit VV was drawn by Professor Rowley, and the curves were drawn also by myself. [918]

Q. What filters were employed in this test?

A. The only filter used was a Farr type 44. The test was started about 6:00 o'clock Friday night and it wasn't finished until about 8:00 o'clock this morning, after working all day Saturday to 11:00 o'clock and all day Sunday, 16 hours on Sunday, then on Monday we started at 6:00 o'clock in the morning and ran 26 hours straight.

Q. Did you and Dr. Rowley agree before making this test that this was the best test that either of you could select for the purpose of answering the court's question providing a comparative test at 519 feet per minute between Professor Rowley's dust and the Farr dust?

A. We discussed the matter and came to that agreement.

Q. Now will you produce the sheet that you have prepared showing the comparative results from that test?

A. (Producing document.)

Mr. Leonard S. Lyon: I ask this be marked Exhibit 31.

(The document referred to was marked Plaintiff's Exhibit No. 31 for identification.)

(Testimony of Sydney F. Duncan.)

By Mr. Leonard S. Lyon:

Q. Will you explain Exhibit 31 to the court.

A. On Exhibit 31, a chart labeled dust comparison tests, there are two efficiency curves plotted. One of them is from the efficiency data provided by Professor Rowley from his test at 300 feet per minute, the other efficiency [919] curve is that obtained over the week end at 519 feet per minute using Rowley's dust.

The efficiency curve obtained by Professor Rowley at 300 feet per minute is the upper dotted line. The efficiency curve obtained for the Farr Type 44 filter at 519 feet per minute over the week end is the upper solid line. The plotted points are shown and somehow or other one of them practically fell off the page due to somebody's tactical error.

The pressure drop at 519 feet per minute for the test run over this past week end is shown as the lower solid line and starts in at approximately .11 inches of water and rises until at the end of the test a point not shown on Exhibit 31 but I believe shown on Exhibit VV, the pressure drop that a dust load of 810 grams was .46 inches.

In the lower part of Exhibit 31 there are two other curves. One of them is a dotted line and is labeled Rowley's test. This is a reproduction of the pressure drop obtained by Professor Rowley when he tested the Farr filter at 300 feet per minute.

The Court: That is JJ and HH?

The Witness: That is JJ, your Honor. The curve labeled Rowley's test at the bottom, the plotted line, is from Exhibit JJ.

(Testimony of Sydney F. Duncan.)

The Court: And what is the other, Duncan's test?

A. The other, Duncan's test, is a plot of data taken [920] over this week end during this particular special test.

The values of pressure drop on the curve labeled Duncan's test are those values which were read when, as the filter loaded during this particular test, the velocity was decreased to 300 feet per minute so that the curves at the bottom of the page could be plotted.

The Court: With identical dust and identical speed as near identical as you could get it?

The Witness: The pressure drops were read at the same velocity. However, the dust was loaded into the filter in one case at 300 feet per minute and in the other case at 519 feet per minute.

The Court: These two at the bottom were run at 300 feet per minute?

The Witness: He ran all his at 300 feet per minute.

The Court: Then you say this is Duncan's test of Farr filter?

The Witness: The test itself ran——

The Court: At 300 per minute.

The Witness: They were just intermediate pressure drops. I decreased it temporarily, read the pressure drop, and ran it back up to 519 feet. The purpose of doing that was to determine what the pressure drop would be on the Farr filter at 300 feet a minute when it had, say, 400 grams of Rowley's dust on it. [921]

(Testimony of Sydney F. Duncan.)

The Court: How did you determine this, that the Farr filter at 519 feet per minute, that the pressure drop increased because it caught more dust?

The Witness: No, because the air was going faster. Or did I misunderstand your question?

The Court: As I understand, the pressure drop occurs because the filter dirties up and it make it harder for the air to get through.

The Witness: That is right.

The Court: Now this pressure drop curve here runs up, the pressure drop for the Farr type 44 filter at 519 feet per minute on Rowley's dust, Duncan's test, that pressure drop goes way up, does it not?

The Witness: Yes, sir.

The Court: Would that indicate, if I understand the testimony, that indicates that the filter is filling up with dirt?

The Witness: That is correct.

The Court: Well, then, in the lower one down here at 300 feet per minute——

The Witness: It is the same amount of dirt in the filter at any given line.

The Court: I see.

The Witness: Take, for instance, a load of 500 grams. At 300 feet per minute through this filter that we were testing [922] over the week end the pressure——

The Court: I see your point. Where they both have 700 grams and both have the same amount of dust in the filter, only the air is going through at

(Testimony of Sydney F. Duncan.)

300 feet per minute and there is not as much air resistance as it is when it goes through at 519 feet per minute?

The Witness: Yes, your Honor.

The Court: We will have the afternoon recess.

(Short recess.)

By Mr. Leonard S. Lyon:

Q. Mr. Duncan, to what do you attribute the difference in the pressure drop curves on Exhibit 31 between the pressure drop curve run at 519 feet per minute and the pressure drop curves run at 300 feet per minute?

A. On Exhibit 31, which shows the same dust load in the filter, the difference between the two sets of pressure drop curves is due to the velocity change.

Q. And not to the difference in the dust?

A. No, because this test has the same dust on it. There is no change in dust in comparing the two velocity pressure drop curves.

The Court: How does that affect the usefulness of the filter from a commercial point of view?

By Mr. Leonard S. Lyon:

Q. I think you are mistaken about what curves I am [923] comparing. I am comparing the pressure drop curve at 519 feet per minute with those at 300. There is two at 300. They were both run with the same dust, is that correct?

A. Yes, they were.

Q. Now to what do you attribute the difference

(Testimony of Sydney F. Duncan.)

between the pressure drop curve at 519 feet per minute on Exhibit 31 with the pressure drop curve at 519 feet per minute on Exhibit 30?

A. The curve labeled Farr type 44 at 519 feet per minute on Exhibit 30 was run with Arizona road dust, all other conditions being as nearly the same as it was possible to make them.

The pressure drop curve labeled Farr type 44 at 519 feet per minute on Rowley dust, Duncan test, on Exhibit 13, used the Rowley dust. The difference, since this is the only variable, the difference is attributed to a difference in the character of the dust.

Q. What do you attribute the dust in the rise to in those pressure curves, what quality of dust or what character of the dust?

A. Principally the fact that it has a larger particle size.

Q. What has?

The Court: You are talking about Exhibit 30 now?

Mr. Leonard S. Lyon: Exhibit 30 as compared with 31 on [924] the two pressure drop curves made at 519 feet per minute.

The Court: Very well.

The Witness: The particle size of the dust, of the Rowley dust, is somewhat larger than the average particle size of the dust used in our laboratory regularly.

The Court: The Duncan dust?

The Witness: The Duncan dust.

The larger particle size makes it easier to catch the particle.

(Testimony of Sydney F. Duncan.)

The Court: The big ones?

The Witness: The big particles.

And since there are more of them there is more weight of dust caught in a given length of time.

The Rowley dust, therefore, loads closer to the face of the filter than the Duncan dust because the Duncan dust is finer. Therefore the Rowley dust, being distributed over a smaller depth of the filter, restricts the passages more rapidly and the pressure rises more rapidly with the dust load.

The Duncan dust being finer and more difficult to catch has to penetrate the filter somewhat further in order to achieve the same efficiency, and so it is distributed down in the filter.

There is a slight indication that since the Rowley dust has a jolted density of .55 and the Duncan dust has a jolted [925] density of 1.18, there is a further indication that perhaps the particles of the Rowley dust have a slightly different shape which makes them a litte more bulky for their mass. But since the tests were run with the same oil at the same velocity with the same amount of oil on the filter each time within about a half an ounce, I think the difference in rate of pressure rise can only be attributed to the difference in dust.

By Mr. Leonard S. Lyon:

Q. Comparing the efficiency curves on Exhibit 31 with those on Exhibit 30, do you find that the difference in the dust materially affects the filter efficiency?

(Testimony of Sydney F. Duncan.)

A. In this particular set of curves, no, there was appreciable effect on filter efficiency.

Q. Now referring to the curve for the Air-Maze type B on Exhibit 11, which was made at 346 feet per minute, using the Duncan dust, what in your opinion difference would it make in that curve if the experiment was run at 519 feet per minute using the Rowley dust?

A. I think the comparison is a little easier to make on Exhibit 11 if we assume that it had been run at 800 cubic feet per minute.

Q. Why?

A. Since the principle of impingement applies in both of these filters, both the Farr filter and the Air-Maze type [926] B show in Exhibit 11, the change in the characteristic shape of the pressure rise curve due to changing from Duncan dust to Rowley dust would be of the same kind and order as that shown on Exhibit 31 when compared with the solid pressure drop curve on Exhibit 11.

In other words, the pressure would have started on the Air-Maze type B filter at about the same point that it did start when using the Duncan dust and then the curve would have risen more rapidly just as the curve did for the Farr filter when the dust only was changed.

Q. Do you find anything in the shape or the magnitude of the curve for the pressure drop with the Farr type filter using the Rowley dust on Exhibit 31 which in any way causes you to differ in your testimony that you gave on direct examination with

(Testimony of Sydney F. Duncan.)

respect to the novel and unique operating characteristic of the patented Farr filter?

Mr. Harris: If the court please, may I have that question reread?

The Court: The long and short of it is, he wants to know if he wants to correct his testimony concerning what the witness considered novel and new and improved or better about the Farr filter over the previous filters.

Is that not your question?

Mr. Leonard S. Lyon: That is correct.

Mr. Harris: Very well. [927]

The Court: Do you want to change your testimony?

The Witness: No, I have no correction to make, your Honor.

By Mr. Leonard S. Lyon:

Q. You intend your testimony to stand and you find no reason to consider that there is anything in connection with this pressure curve on Exhibit 31 that conflicts with your testimony, is that what you mean?

A. Exactly, since the only difference between the pressure drop curve on Fig. 31 and the pressure drop curve for the Farr filter on either Exhibits 11, 13 or 30, is that the dust was changed.

Q. Have you prepared a chart of the elements of Claims 4, 5, 7 and 8 of the Farr patent in suit and applied to that chart indications as to whether or not those elements are present in the various exhibits from the prior art and the accused structure

(Testimony of Sydney F. Duncan.)

involved in this case? A. Yes, I have. [928]

* * * * *

(The document referred to was marked Plaintiff's Exhibit No. 32 for identification.)

By Mr. Leonard S. Lyon:

Q. Did you prepare this chart?

A. Yes, I did.

Q. In the first column of this chart there is set forth the elements as you find them of Claims 4, 5, 7 and 8 of the patent in suit. A. Yes.

Q. In the next column, entitled Air-Maze P-5 and Schaaf, have you set forth whether or not you find those elements in the accused P-5 structure?

A. Yes, I have. The Air-Maze P-5 and Schaaf refers to a patent whose number I don't think of now. [929]

* * * * *

Q. Will you take Defendant's Exhibit PP and Plaintiff's Exhibit 15-B and with those explain how, in determining that the P-5 accused filter, the row of holes in Exhibit PP, illustrates how there are five different places in the accused P-5 filter where that filter is subdivided into two dimensions?

A. May I have the exhibits, Mr. Clerk?

(The exhibits referred to were passed to the witness.)

The Witness: In Exhibit PP there are five rows of holes that extend through the exhibit. These holes represent contact areas between crimps of screen where one crimp crosses another crimp and makes

(Testimony of Sydney F. Duncan.)

a contact area at that point. The metal of which this is cast could not flow into that area because of this contact.

The contact occurs as shown by the holes in five different places running from the air inlet side of the model to the air outlet side of the model. The holes are pretty well lined up so that a plane passed through the filter parallel to its face would include a stack of these points or areas, small areas, where screen of one crimp contacts the screen of the crimp either below or above it.

Air flowing into any one of the passages is constrained to flow around these contact points.

The only way at these planes of preferable thickness that the air could get from one passage into another is to [930] flow through the mesh of the screen member. So these contact areas, arranged as they are in a quite definite pattern, constitute a division of the airstream that takes place at five places through the filter as shown by this model which is Exhibit PP.

In looking at Exhibit 15-B and allowing the light to shine through it, it becomes apparent to me that these contact areas are definitely areas and not simply points, that air is again constrained to flow around these areas as it follows the Z-shaped passages in the crimp.

This constitutes a division of the approaching air flow into many, many small filaments of air so that the dust borne by the entering air will be brought into close contact or at least near to a dust

(Testimony of Sydney F. Duncan.)

collecting surface.

By Mr. Leonard S. Lyon:

Q. Will you compare that with the action of the subdivisions formed by the wire gauze in the Farr patent in suit?

A. Well, the mesh screen members of the Farr patent accomplish the same thing. There are areas of contact between the crests of the crimps and the other screen.

The Court: The flat screen?

The Witness: The flat screen in this case as shown in Exhibit 3. [931]

By Mr. Leonard S. Lyon:

Q. Now will you turn to the next column on Exhibit 32?

The Court: That is Claim 4?

Mr. Leonard S. Lyon: No, that is headed "St. Cyr."

The Court: Under Claim 4? You have Claim 4 here.

Mr. Leonard S. Lyon: I have Claims 4, 5, 7 and 8 in the suit, but the elements of all of those four claims are all subdivided and set forth separately in the column of Exhibit 32 entitled "Elements of Claim."

The Court: All I am trying to find out is which page of the chart you want him to look at. The one headed Claim 4?

Mr. Leonard S. Lyon: Yes, your Honor.

The Court: Very well.

By Mr. Leonard S. Lyon:

(Testimony of Sydney F. Duncan.)

Q. Now under the title "St. Cyr" have you indicated your opinion as to whether or not the elements of Claim 4 are present in the St. Cyr patent?

A. Some of them are and some of them are not.

Q. But you have indicated which?

A. I have indicated; yes.

The Court: Let me see, St. Cyr has the air flowing across the surface instead of through it, is that it?

By Mr. Leonard S. Lyon:

Q. The first point, do you find in St. Cyr a filter panel operating on the principle of impingement of particles [932] on collected surfaces?

A. Well, I don't call it a filtering panel.

Q. What difference do you make of it?

A. It is an evaporator type of device.

Q. You indicated opposite No. 3 that the St. Cyr device is not formed with mesh screen members.

A. According to the teachings of the patent in suit it is required in the Farr patent that the screen material be of sufficiently open mesh so that when coated with oil air may flow through the mesh of the screen.

In the St. Cyr device he refers rather frequently to wire gauze, gauze fabric and in particular, on line 15 of the first column, page 1, "consists of a strip of fine metal gauze." In my opinion the fine metal gauze if coated with oil would not allow the air to flow through the mesh and so I have entered a "no" opposite Item 3, Claim 4, mesh screening members, no, in the teachings of the Farr patent.

(Testimony of Sydney F. Duncan.)

Q. Now the next item that I call your attention to is No. 6, the walls of which passage are coated with such mesh members. You indicated "no" and I suppose your answer is the same?

A. My reasons are the same there, that when coated with oil this material would not allow air to flow without it and so far as air flow is concerned, it would present a solid wall. [933]

By Mr. Leonard S. Lyon:

Q. And the next element No. VII, which refers to "said passages changing direction," why do you say "no," that that element is not present in the St. Cyr device?

A. I believe there has been some discussion of the change in direction with respect to Plaintiff's Exhibits V and W.

The change in direction described in Exhibits V and W, in the direction or angle of necessarily straight crimp, chosen in making these exhibits, is an accident of their being wrapped around a cylinder.

The change in direction described with respect to Exhibits V and W is what might be called a uniform change in direction; there is no abrupt change in direction.

There was apparently no particularly intended change in direction, other than that indicated in the St. Cyr patents, in Fig. 5, and the direction of these special corrugations was made annularly to the edge of the strip, and so I have entered a "no."

Q. Now, on the next item, No. VIII, which re-

(Testimony of Sydney F. Duncan.)
fers to the statement in claim 4 that "whereby the medium may flow through * * * said members near the entrance of the panel when the filter is clean and partially through said passages and thence through * * * the members located progressively toward the exit of the panel as the panel becomes [934] progressively loaded with particles," you say that is not present in St. Cyr. Why do you say that?

A. The same reasoning applies to item VIII in column 1, on claim 4; the "no" under St. Cyr is that where they say "filtering panel" and were it oiled as we have been discussing, then the fineness of the mesh of screen would prevent air flowing through the screen because of the presence of oil in the mesh of the screen.

Q. Now, referring to the next column on this same page 1, claim 4, entitled "Henshall," have you there entered which of the elements of claim 4 you believe are present in Henshall and which you believe and absent? A. Yes.

Q. Referring to item III, the "mesh screening members," you have indicated that those were not present in Henshall. On what do you base that statement?

A. Henshall discloses perforated plates in his dust-collecting surface and is quite particular about the hole size of those plates.

On page 2, column 1, line 27, he starts, "the apertures being one-sixteenth (1/16") in diameter," referring to the holes punched in one of the plates.

Lower down on the same page in the same column,

(Testimony of Sydney F. Duncan.)
line 30, "apertures 25 which are smaller, being three sixty-fourth (3/64") in diameter. They catch the smaller particles of [935] dust or soot, passing the first section."

Again a size is referred to in the same column in line 40, "one thirty-second (1/32") of an inch in diameter."

This is not a mesh screening member or woven wire. It is a perforated plate.

The Court: But in the Henshall patent, the air does flow through the filter without the necessity of flowing through these holes?

The Witness: That is true, your Honor.

The Court: All right.

The Witness: There is some doubt in my mind whether one thirty-second of an inch hole might not be filled easily with oil, but he discloses in the patent that his intention was to have the air flow through the holes or through these——

The Court: Through the passages?

The Witness: ——sheath-like passages.

The Court: Through the passages and the holes?

The Witness: Yes.

The Court: And flows along the surface. In other words, the passages are along the plane of the surface of whatever it is, the metal.

The Witness: Yes, your Honor.

The Court: It is not at right angles to it?

The Witness: Except in a change of direction, but in general it follows the —— [936]

(Testimony of Sydney F. Duncan.)

The Court: Well, the entrance is not at right angles.

The Witness: No. The entrance is generally parallel except for the initial change of the first sheet.

By Mr. Leonard S. Lyons:

Q. And the next element of claim 4 that you have indicated under Henshall, which is item IV, you have indicated as not present. Upon what do you base that opinion?

A. The sheets of perforated plate in the Henshall patent divide the panel or subdivide the panel in only one dimension and not in two dimensions. There is no face view of it, but looking at Fig. 2, it shows at the upper portion a cut-away end view of the plates which Henshall has assembled, the dimension which is perpendicular to the piece of paper on which the figure is drawn is not divided in any manner by the plates. Such a dimension simply passes along parallel to the front edge of one of those plates, and there is no division.

Q. You have indicated again opposite item VI of claim 4 that Henshall does not have that item. Is that based on the same reason you gave in connection with item III?

A. Yes. These are perforated plates and not screen mesh.

Q. With respect to your testimony that Henshall does not have multiple subdivisions in both dimensions perpendicular to the general direction of flow of the medium to be filtered, what in your

(Testimony of Sydney F. Duncan.)
opinion difference would that make in [937] the operating characteristics of the filter?

A. This lack of the subdivision in both dimensions divides the approaching air stream into a series of sheets.

Mr. Harris: Excuse me. If the Court please, may I ask on voir dire if this witness has ever seen one of these devices made like the Henshall?

Mr. Leonard S. Lyon: Yes.

The Witness: Yes.

Mr. Harris: You have seen one of these?

The Witness: Yes, I made one.

Mr. Harris: Very well. What size, if I may ask?

The Witness: It was a 20 by 20 panel.

Mr. Leonard S. Lyon: Will you finish your answer, if you haven't?

The Witness: The lack of the multiple subdivision in both dimensions lets the air flow through the panel in parallel sheets rather than in many small filaments. For instance, in a 20 by 20 panel, if you space the plates about a quarter of an inch, which is about the spacing of the layers in the Farr filter, and—well, the P-5, I think, has five layers to the inch—would be about 78 or '9 layers, which would make about 78 or '9 subdivisions of the air stream.

In the Farr filter, since it is divided in approximately quarter-inch spaces in both dimensions, there would be 78 [938] squared, or something—what is it?——

The Court: I don't know.

(Testimony of Sydney F. Duncan.)

The Witness: —62,000 divisions of the air flow.

By Mr. Leonard S. Lyon:

Q. Now, referring to the next column for claim 4, have you there set forth the elements of claims 4 which you find present and the elements which you find absent in the Greene patent in evidence?

A. Yes, I have.

Q. You state that item II is not present. Will you state on what basis you formed that opinion?

A. The Greene patent quite definitely discloses that all of the air must flow roughly perpendicular to the screen layers of which the Greene patented filter is built, and, therefore, the members do not extend in the general direction of the intended flow of the medium but extend in a direction perpendicular to the general intended flow of the medium to be filtered.

Q. You have indicated opposite V that that element is absent. Is your answer the same as to that element?

A. There are no intentionally formed passages. Any material through which some fluid may flow must have a passage, but there are no intentionally formed passages in the Greene filter, the same kind of passages that you would have perhaps in a sand bottom and with water percolating through it, they are haphazard, accidental, and not passages in the sense that the passages could be cast in metal as in Exhibit PP.

Q. And for that same reason you find that item VI of claim 4 is not present in Greene, is that correct?

(Testimony of Sydney F. Duncan.)

A. Yes. The mesh screening members don't lie in the right direction.

Q. Item VII of claim 4, which refers to the passages and change in direction, you have indicated that you don't find that in the Greene patent?

A. Well, I don't find the passages, so they don't change in direction.

Q. Adn you have indicated that item VIII in the Greene patent is not present? A. Yes.

Q. Will you explain the reason for that opinion?

A. In the Green patent, all of the air has to flow through each of the screens in sequence and it has no choice.

The Court: At right angles?

The Witness: At right angles to the plane of the screen, and so it has no choice but to flow through all of them in sequence. Therefore, there is no choice to flow parallel, so that item VIII is absent.

By Mr. Leonard S. Lyon:

Q. Now, in the next column, entitled "Preble," have you set forth your opinion as to whether or not the elements [940] of claim 4 are found in the Preble prior patent? A. Yes, sir, I have.

Q. You state that item III is not present. On what do you base that opinion?

A. Well, Mr. Preble describes a filter which is made of three sections. The inlet side, referring to Fig. 11, is some kind of expanded metal or screen or material of that nature, the plane of which is perpendicular to the air flow.

On the outlet side there are other layers of ex-

(Testimony of Sydney F. Duncan.)
panded metal, 32, 33, and 31, which are again perpendicular to the direction of flow.

The center section of Preble, made up of, as described in the patent, various kinds of material and designated in Fig. 11 of the patent as 29 and 30, with spaces 28 in between, are not described as being made of mesh screen members.

The Court: Fig. 5. He calls them reinforcing ribs.

The Witness: Fig. 5.

The Court: At 29, it alternates with 30. I see. It is a reinforcing element, and then what he calls a strand, as Fig. 3.

Mr. Leonard S. Lyon: In view of the last answer——

The Witness: Yes, Fig. 3, your Honor, is a view of a kind of expanded metal.

The Court: Yes.

The Witness: And on page 2, column 2, line 94, it [941] begins, and I quote: "The main filtering media within the filter cell comprises a stack 28 (Fig. 11) of viscous-coated diversiform expanded metal sheets each of which is arranged in a plane normal to the inlet opening 16."

Down below, in that same column, column 2, page 2, line 102, at the beginning of the paragraph, "Preferably the stack 28 is composed of 80 double-mesh herringbone expanded metal sheets 29 (Figs. 5 and 6) and 80 corrugated expanded metal sheets 30 (Figs. 7 and 8) alternately arranged," so that at no place does he describe making the middle section of the filter, where the flow may be in general par-

(Testimony of Sydney F. Duncan.)

allel to the planes of the material used, and no place does he describe the use of screen.

By Mr. Leonard S. Lyon:

Q. In view of your testimony, will you explain the basis for your opinion that item II is present in Preble?

A. The description in the patent says, one of the quotes read, beginning at line 94 of column 2 on page 2, "expanded metal sheets each of which is arranged in a plane normal to the inlet opening 16."

The Court: The drawings do not show that, do they? I mean they show that, but they also show the screen behind.

The Witness: Well, the center section of the device has plates of various kinds of material in general laid parallel to the direction of the intended flow of the medium. The front screens and back screens are expanded metal protection sheets [942] depending on the particular choice of the maker.

The Court: It says "two sheets of wire screen." That is 33.

The Witness: Well, 33 is a fine screen. It is shown at Figs. 9 and 10.

The Court: Then there are three of those?

The Witness: Yes.

The Court: What is your answer as to that?

The Witness: Well, in connection with that part of the filter, my answer to II under Preble on this claim 4, which we are discussing, is that for that part of the filter the answer is no. For the center section, it is no. And for the inlet side section where

(Testimony of Sydney F. Duncan.)

we have 31 and 32 extending entirely across the face of the filter in that section, the answer is no.

By Mr. Leonard S. Lyon:

Q. Now, you have indicated that items V, VI, VII, and VIII of claim 4 are absent from Preble. Will you state the basis for your opinion as to those items?

A. My reasoning there is based principally on his repeated description of this center section as being a stack of diversiform expanded metal, or on page 1 of the patent, line 67, column 2, he says, "of a stack of densely compacted diversiform foraminous viscous-coated sheets arranged within the cell with the end faces on one side of the stack directed [943] towards the inlet opening."

In describing the material this way, he draws for me a picture of something which is squashed down together and has haphazard passages through it but no well-defined passages.

Q. Now, with reference to the next column on this page of Exhibit 32, under the title "Slauson," have you there indicated your opinion as to whether or not the elements of claim 4 are in the prior patent in evidence? A. Yes, I have.

Q. You have indicated that item III is absent. What is your reason for that?

A. The Slauson patent states quite clearly in several places that the material to be used is a wool felt or cardboard that will absorb oil or something of that sort, and does not disclose anything

(Testimony of Sydney F. Duncan.)
about the use of wire screen or screen members in which, when oiled, the mesh will remain open.

Q. You have indicated that element VI in claim 4 is absent from Slauson. What is your reason? Is your reason the same?

A. Since there is no screen, there can be no passages with screens.

Q. And you have indicated that element VIII is absent from Clauson, What is your reason for that? A. For the same reason.

Q. The next column is entitled "Orem." You have [944] indicated that item IV of claim 4 is absent from Orem. Will you state the basis of that opinion?

A. The construction here, according to the drawings, at least, is slightly similar to the Henshall patent in that such subdivision of the air stream as might possibly be conceived to occur is in the form of several concentric, annular spaces, and one interpretation of the drawing, including all the arrows and his statement that thet air may flow through the screens, when it is clean, and down along this cylindrical screen to a hole at the end, and carry into a kind of a plenum chamber and then back through some other annular space, if the screen were entirely plugged with dirt, as it might be under prolonged operation, there would really be only one passage through the filter, and that would have to be through each one of the concentric annular spaces in series.

The Court: Well, if all the screens in the Farr

(Testimony of Sydney F. Duncan.)

were plugged with dirt, there would still be multiple passages?

The Witness: 62,000 passages, more or less.

By Mr. Leonard S. Lyon:

Q. Now, you have indicated that item V is absent and that item VI is absent and item VII is absent from the Orem patent. What is your basis for those opinions?

A. Very much as I explained before. This filter constitutes a one-passage which is bent back and forth on itself, so to speak, and air simply passes through this passage along [945] the surfaces of screen and can, under conditions of clean screen, flow from one portion of the passage to another portion of the passage through the screen wall.

So, in the teaching of the Farr patent, where there are many passages parallel to each other in effect through the filter, this construction described by Orem does not, in my opinion, meet these requirements. [946]

Q. Your next column is entitled "Merriweather." You have indicated that Item 4 or Claim 4 of the Farr patent is not found in the Merriweather prior patent. What is the basis for that opinion?

A. The opinion here with respect to Merriweather and the multiple subdivision in two dimensions is the same as for the Henshall patent under the same problem.

The screens or frames in wire gauze—he refers to them as screens 23 and wire gauze 23-A—form

(Testimony of Sydney F. Duncan.)

subdivision in only one dimension of the panel rather than two. So the answer there must be no, since it is not in both dimensions.

Q. You have indicated that Item 7 of Claim 4 is not found in Merriweather. What is the basis for that opinion?

A. The passages being formed by the wire gauze 23-A in the frames and set parallel to each other do not change direction from the beginning of the passage to the end of the passage, so there is no change of direction in the passage itself.

Q. The next column under the title "Kaiser" you have set forth that you do not find Item 3 in Claim 4 in the Kaiser patent. What is the basis for that opinion?

A. The Kaiser patent teaches that the material should be paper and as such it is relatively impervious to the flow of air and it doesn't take on the characteristic of a screen at all. [947]

The Court: You saw that example made today and produced by Mr. Brown, did you?

The Witness: Yes.

The Court: Of screen?

The Witness: Yes.

The Court: And do you not think that that conforms to the teachings of the Kaiser patent?

The Witness: No, I do not, your Honor.

The Court: Solely because it is made out of screen instead of paper?

The Witness: Well, by so doing he introduced a new factor in the operation of that device as a filter.

(Testimony of Sydney F. Duncan.)

By Mr. Leonard S. Lyon:

Q. What new factor of operation would the device have?

The Court: It is screen wire instead of paper. In other words, it provided a turbulence for the air to flow through the interstices of the wire and flow through the passages?

The Witness: That is right.

By Mr. Leonard S. Lyon:

Q. What else, with reference to the loading of the device?

The Court: Loading?

The Witness: I think he refers to the progressive loading shown by those photographs of the filter. [948]

By Mr. Leonard S. Lyon:

Q. In that respect, does the Farr filter have a mode of operation that is not had by the paper filter of the Kaiser patent?

Mr. Harris: Now is counsel referring to the paper filter as made by the Kaiser patent or to the Kaiser type filter made of screen wire?

Mr. Leonard S. Lyon: If this screen wire device existed in the prior art, your Honor, there wouldn't be any law suit here. This is not a device that is in the prior art and our argument is that it is not merely a change of material.

* * * * *

The Court: That was given in the answer to your previous question.

The Witness: I thought so. [949]

(Testimony of Sydney F. Duncan.)

The Court: The turbulence of the air and the flow of the interstices of the screen, the change of direction, and so forth.

The Witness: Yes.

By Mr. Leonard S. Lyon:

Q. And the progressive loading.

The Court: Progressive loading.

The Witness: Yes, your Honor.

The Court: What else about the Kaiser patent?

Mr. Leonard S. Lyon: Item 8 I think is explained in his answer.

The Court: Yes.

By Mr. Leonard S. Lyon:

Q. Returning now to the Manning patent, you have indicated that the same elements are absent from the Manning patent as are absent from the Kaiser patent. Is your opinion based on the same reasons in the case of the Manning patent?

A. Yes, they are. The Manning patent teaches paper and impervious walls to the passages.

Q. Next we have reference to the Wood patent. You find Item 3 of Claim 4 absent from the Wood patent. What is the basis of your opinion?

A. The Wood patent discloses a number of devices, most of which are intended to catch and drain off some entrained liquid in an airstream. This catching of an entrained liqud [950] will also collect such dust as may be in the liquid and give same air cleaning. But the only thing that would be classified by me as a panel type air filter operating on the principle of impingement is shown in

(Testimony of Sydney F. Duncan.)

Figs. 12, 13, 14 and 15 of the Wood patent. In the description of these figures there is no mention made of making this filter out of mesh screen members; therefore the answer to No. 3 is no.

Q. What is the basis of your answer that element 6 is absent?

A. Well, there is no screen so how can the walls be made of screen?

Q. What is the basis for your opinion that Item 7 is absent?

A. All descriptions of this filtering device describe only straight crimps. There is no change in direction of the crimp or change in direction of the passages as formed by the crimps.

The Court: And impervious material?

The Witness: And it is impervious material.

The Court: Either paper or sheet metal?

The Witness: Yes.

By Mr. Leonard S. Lyon:

Q. And that explains the reason for your statement that Item 8 is absent?

A. Item 8 is absent.

Q. In the next column you have set forth your fiindings [951] with respect to the presence of the element in the Farr patent in suit? A. No.

Q. I don't mean in suit, in evidence. You state that Item 7 and Item 8 are absent and under Item 1 that this patent does not disclose a filter panel operating on the impingement principle. Will you state the basis for your opinion as to the absence of those three items?

(Testimony of Sydney F. Duncan.)

A. To make clear the term impingement, the rotor shown in Fig. 3 and, as I believe it says in Fig. 1, it turns and the lower portion of it dips into a tank of water which is either 14 or 15 in Fig. 1. Such dust as may have accumulated on it during its revolution will be washed off by the water and the device will present a continuously relatively clean surface to the air. So in distinguishing between this and a filter panel, a panel filter collects the dust and holds it until sometime after a period of perhaps months it is taken out and cleaned by some other than a built-in agency.

So that is the reason why in the Farr patent '480 I say no, it is not a filtering panel.

Q. I believe you have already testified that you have been familiar with the manufacture of the evaporative devices under this Farr patent, have you not? A. Yes, I have.

Q. In operation, how fast does the device rotate?

A. Just about one-half revolution a minute, so that about every 40 seconds a particular spot on the rotor is dunked in the tank of water.

Q. I show you Plaintiff's Exhibit 26. Can you identify what that is a picture of?

A. This is a picture of one of the rotors built according to the Farr '480 patent.

Q. You have indicated on Exhibit 32 that Item 7 of Claim 4 is not present in that device. Can you demonstrate that fact by this Exhibit 26?

A. On Exhibit 26, which was taken against a fairly light background, it is possible in an area

(Testimony of Sydney F. Duncan.)

just near the center of the photograph to see straight through the crimps. That rotor is six or eight inches thick in a direction perpendicular to the plane on its face.

At other points in the photograph it will not be possible to see through the crimps on account of the angle of view.

Q. Can you see through it only at one point in the device or at a plurality of points?

A. You can see through it at any point of the device from the hub to the outside depending upon the direction you look.

The Court: In other words, you can see through it wherever you are looking through it?

The Witness: Right, your Honor. [953]

By Mr. Leonard S. Lyon:

Q. Now the next column on this page of Exhibit 32——

The Court: You say this does not work on the impingement principle?

The Witness: No, your Honor. I said that it would collect dust, such duct as it would collect will be by the impingement principle, yes, but it doesn't store it like a panel filter does. And that is the reason Claim 8 has a "no" on it.

Mr. Leonard S. Lyon: You mean Item 8?

The Witness: Item 8 under Claim 4 has a "no," because it is continuously washed and the plugging situation does not exist.

The Court: The impingement then does not occur against the screen material because of any

(Testimony of Sydney F. Duncan.)

viscous coated material but because the screen is damp, is that it?

The Witness: Well, impingement means that something hits something else, and whether the screen is coated or not, dust particles must impinge thereon. If there is an adhesive, such as oil, then a dust particle impinging on the surface of the screen wire can be caught and held. To a certain extent water will act as an adhesive but in this device, in the Farr '480 patent, the water is continuously evaporating so that it doesn't present much of an opportunity to catch dust particles.

The Court: That water itself catches the dust particles? [954]

The Witness: The water itself catches the dust particles and holds them.

The Court: In other words, the idea is to have the water dripping through so that the air passes along the water and comes back down?

The Witness: The water doesn't drip in this device, it simply coats the screen and evaporates from the surface.

The Court: Does it not say there in the patent some place that as it goes around it trickles down and around?

Mr. Leonard S. Lyon: That is a different patent.

The Court: I thought it was this one.

The Witness: It doesn't say that it trickles down around and through.

(Testimony of Sydney F. Duncan.)

The Court: Well, maybe you have a fancy word for "trickles."

The Witness: The direction of the crimp provides——

The Court: Well, on page 1, column 2, line 10, it states: "in this way (this is after describing it) the air current passing through the purifier will be baffled and broken up, as it were, so that all the molecules of air passing through the purifier must come in contact with the moisture-laden areas."

The Witness: Speaking of the then water coating on the surface of the wire.

The Court: "In practice this effect is practiced preferably [955] by providing a reticulated body, the lower edge of which dips into a bath of liquid or water and as the purifier rotates its wetted upper portion carries a considerable quantity of water which continuously gravitates downwardly"—that is what I meant by trickle—"gravitates downwardly so that all of the reticulated areas of the purifier carry moisture to contact with the flowing airstream passing through the purifier."

It does not stay down, it runs along the edge.

The Witness: It runs along the surface of the wire and that action takes place principally where the rotor is emerging from the bath of liquid.

The Court: What is meant in all these patents here in your opinion where it says that the impingement principle is used? Does that not mean that the dust particles impinge upon the screen or whatever it is that is coated and stay there?

(Testimony of Sydney F. Duncan.)

The Witness: That is right, and opposed to the filter paper type of action, of filtering where the hole through which the air can pass is smaller than the particle approaching the filter paper.

The Court: That is where they are introduced at right angles to the filter paper?

The Witness: Yes.

The Court: But if it is introduced through these—— [956-957-958]

The Witness: As in the Kaiser and Manning?

The Court: As in the Kaiser and Manning.

The Witness: Then it is operating on the impingement principle.

The Court: In other words, by "impinging" it means to hit and stick?

The Witness: Well, hitting is sufficient for impingement. That is the distinction.

The Court: What is the use of having the dust hit it if it does not stick?

The Witness: That is why we oil our filters.

The Court: How do you describe that other than using the word "impingement"?

The Witness: The dust certainly impinges on the outside surface and sticks; yes, your Honor.

The Court: But it does not on the Farr '480 patent?

The Witness: It does not stick very well.

The Court: It sticks long enough to be taken down into the water bath?

The Witness: Some of it does.

The Court: Very well.

(Testimony of Sydney F. Duncan.)

By Mr. Leonard S. Lyon:

Q. The next column, which is labeled "Row (British)," you have indicated that that is not a filter panel operating on the impingement principle. What is the basis of your [959] opinion as to that?

A. The teachings of the Row patent——

The Court: Did you skip the Kirkham patent? No, that comes next. I have my book wrong. Go ahead.

The Witness: In Figure 3, particularly of the Row patent, there is a little pipe H up at the top which delivers water to a kind of pan on top of the unit. The patent teaches that water seeps out of this pan and flows down the various kinds of surfaces that Row interposes between the top and the bottom of his device, and that the seeping of water continually cleans the surfaces of dirt and the pipe I at the bottom of Fig. 3 is described as an overflow to prevent flooding. [960]

The Court: Does the water, droplets of water or whatever you call them, act there to gather upon themselves the dirt that is in the air?

The Witness: Just the same as in the Farr device.

The Court: Well, what I am trying to get at is that when it rains it cleans the air. Now, that isn't just because it settles the dust on the ground, but because the water coming down gathers the dust as it passes through the air, does it not?

The Witness: Yes.

(Testimony of Sydney F. Duncan.)

The Court: Well, does it do the same thing in the Farr rotary device?

The Witness: Except that we don't have the droplet situation existing.

The Court: Does it do the same thing here in the Row device?

The Witness: Yes. The water will collect dust out of the air.

The Court: Go ahead.

By Mr. Leonard S. Lyon:

Q. Now, you have indicated that item III—that item IV is not present in the Row device. What is the basis of your opinion as to that?

A. Well, at no place in the Row device does he teach other constructions than parallel plates or something or [961] other. Although these plates may be bent, there is no subdivision except in one dimension. Lines parallel to the edges of one of these plates, such as shown in Fig. 1 or Fig 3 or taking into account the direction of air flow in Fig. 2 of the front edges of those plates, would present a series of straight lines up and down the device, and so there is no subdivision in two dimensions —only one.

The Court: Well, suppose that the plates shown in Figs. 1 and 2 were made of the material shown in Figs. 7 and 8, then wouldn't the flow be in two dimensions?

The Witness: There would be no subdivision if the plates of 1 and 2 were made of the material of 7, 8, 9, and 10—well, we should say 7 and 9.

(Testimony of Sydney F. Duncan.)

The Court: 7 and 9?

The Witness: Then we would have a device which would be similar to Merryweather with the addition of a change in direction, that is, if you use Fig. 2 as an example.

By Mr. Leonard S. Lyon:

Q. You have indicated that element VIII of claim 4 is not found in the Row patent. What is the basis for that opinion?

A. The teachings of the Row patent being that the water shall keep it clean, renewing the water on which the dust may collect, there is no progressive loading or change of flow through the device from time to time. [962]

Q. Now, the next column has reference to the prior Kirkham British patent. You have indicated that that is not a filter operating on the principle of impingement. Is your reason the same in the case of the Kirkham patent as you gave in the case of the Row patent?

A. And the Farr '480 patent, yes. This is described as being a gas scrubber.

Q. What is the difference between a gas scrubber and a panel filter operating on the impingement principle?

A. Well, the panel filter similar to the patent in suit collects dust and holds it until some considerable time later it is cleaned, whereas, in the gas scrubber described, the usual engineering understanding, so to speak, is to bring some liquid in contact with some gas so that a portion of the gas

(Testimony of Sydney F. Duncan.)

may be dissolved in the liquid or that a portion of the liquid may be vaporized into the gas stream.

Q. Now, you have indicated that element III of claim 4 is not found in the Kirkham patent. Do you find in the Kirkham patent any reference to the mesh screening members?

A. There is a reference to wire gauze on page 2 of the patent, the paragraph beginning at line 9. It says:

"According to our invention we make use of sheets of corrugated metal or wire gauze, which may be laid one against the other or against flat boards or other surfaces," and so on. [963]

There seems to be no intention in the patent of having this material of coarse mesh, and while the exact definition of "wire gauze" is unavailable, probably, perhaps non-existent, the general connotation of the term is "material of rather fine mesh."

And so, in the teachings of the Farr patent that the mesh of a screen material, the woven wire material must be sufficiently open so that when oiled air may flow through the openings, I have put a "no" down under the "mesh screening members" of the Kirkham patent.

The Court: Well, isn't the air compared as a form of gas——

The Witness: Yes.

The Court: ——in your business?

The Witness: Yes.

The Court: Now, if I understand you correctly, the principle of the Kirkham patent and the Row

(Testimony of Sydney F. Duncan.)

patent by which the air is cleaned is by the use of water.

The Witness: That is correct.

The Court: To clean the air.

The Witness: That is correct.

The Court: And these are devices to bring droplets or mists of water in contact with the particles in the air?

The Witness: Not necessarily mists, but water.

The Court: Well, not necessarily mists, but some kind [964] of water. So that the water operates as the media for collecting the dust.

The Witness: Yes, sir.

By Mr. Leonard S. Lyon:

Q. You have indicated that the last three elements, Nos. VI, VII, and VIII of the claim 4 of the patent in suit, are not found in the Kirkham patent. Will you state the basis for those opinions?

A. Item VI, "the walls of which passages are composed of such mesh members." For instance, he speaks of "wire gauze," and in general practice that is characterized to almost any engineer as being a fine material which would be plugged by dipping it in oil, since the passages are not of sufficiently open nature to pass air, so then, automatically, items IV, V, and VI—well, excuse me—VI and VIII are "no."

In item VII I find no change in direction of any crimps in the Kirkham patent, so the answer is "no."

Mr. Harris: If the Court please, I move to

(Testimony of Sydney F. Duncan.)

strike the portion of his answer saying that any engineer would know. I think he can state what he would know or what his opinion would be, but to give an opinion as to other engineers, I think that should be stricken.

The Court: All of his testimony here is his opinion, his opinion as to what any engineer would know. [965]

* * * * *

By Mr. Leonard S. Lyon:

Q. Continuing with Exhibit 32, Claim 4, the next column refers to the Moller (British) patent, and you have indicated on the exhibit that you do not find the first element of Claim 4 in that patent.

Are your reasons the same in that instance as they were for your similar conclusion with respect to the Row, Kirkham and Farr evaporator patents?

A. Yes, they are, since this is a device which is continuously washed and under these conditions the dirt does not build up in the filter or it is not loaded over a long period of time but it is rather clean quite frequently.

Q. You have indicated that you do not find the third element in the Moller (British) patent. What is the basis for that opinion?

A. I find no place in the patent where it describes [973] the construction of mesh screening members. The patent describes them embossed or——

Q. You have next indicated that you do not find the sixth element of Claim 4. Is that based

(Testimony of Sydney F. Duncan.)
on the same reasoning that you just gave with respect to the third element? A. Yes.

Q. And you indicate that you do not find the last element in the moller patent. Will you state the basis for that opinion?

A. The last element calls for flow through the members and these members of the Moller patent are made out of sheet metal and therefore there can be no flow through them, only between them.

Q. This last element of Claim 4 calls for what you have referred to in your testimony as the progressive loading mode of operation.

A. Yes, it describes it.

Q. Now the last column on this page of Exhibit 32 sets forth your findings with respect to the prior Niestle (French) patent, and you have indicated in the first place that you do not find the second element of the Niestle (French) patent. You do not find the second element of Claim 4 present in the Niestle patent. Will you state the basis for that conclusion?

A. The sheets of deformed screen or expanded metal [974] type of screening material in the Niestle patent lie perpendicular to the direction of the flow of air.

Q. Will you demonstrate that to the Court with the model of the Niestle patent which the defendant produced, Dr. Rowley? A. Exhibit CC.

The Court: There were two. Mr. Brown introduced one.

(Testimony of Sydney F. Duncan.)

The Witness: Exhibit CC is the sheet of screen that has been deformed.

Mr. Leonard S. Lyon: I want you to demonstrate your answer with the model of the Niestle filter.

The Witness: That is Exhibit YY.

Mr. Leonard S. Lyon: We don't recognize this as a Niestle patent device, your Honor.

The Court: Dr. Rowley produced one that was all full of soot.

The Witness: That is Exhibit LL.

Mr. Leonard S. Lyon: We can put both Exhibits YY and LL in front of the witness and he can refer to them in his answer.

The Witness: And may I have CC?

Mr. Leonard S. Lyon: What is that?

The Witness: That is a piece of screen wire that has been expanded.

(The exhibits referred to were passed to the witness.) [975]

The Witness: Exhibit YY is a 7 x 7 sample of a Niestle filter and Exhibit CC, although it is made of 30 mesh instead of 16 mesh screen, is an example of the sheets that were used to make Exhibit YY.

The sheet of screen deformed as it is in Exhibit CC is placed in the frame of Exhibit YY parallel to the face of the frame so that the sheet or the plane of the sheet of deformed screen is perpendicular to the direction of air flow.

As viewed through the window——

(Testimony of Sydney F. Duncan.)

The Court: In other words, the air flows at right angles?

The Witness: At right angles to the plane of the sheeted screen.

As viewed through the window of Exhibit YY, it appears that there are six of the sheets similar to Exhibit CC used in making Exhibit YY and each one of them is at right angles to the air flow.

By Mr. Leonard S. Lyon:

Q. You have indicated next on Exhibit No. 32 that you do not find in the Niestle patent the third element of the fourth claim of the patent in suit, to wit, "mesh screening members." What is the basis for that opinion?

A. In the sense in which "mesh screening members" is used in the Farr '479 patent, the requirement is that the apertures of the screen shall be open when oiled, so that air may flow through them. I find no such teaching in the Niestle patent because he repeatedly refers to the mesh of the screen, or the holes in the perforated plate, which he states is an alternate construction, as being small enough so that they shall fill with oil completely, and in one place he says, "to fill the meshes by capillary action."

The Court: " . . . and form a continuous, thick film of oil, favoring the deposition of the dust suspended in the gas."

The Witness: Yes. On my typing of the translation I can't refer to lines in it because I think it is different from the one in evidence.

(Testimony of Sydney F. Duncan.)

By Mr. Leonard S. Lyon:

Q. You have indicated in Exhibit No. 32 that you do not find the sixth element of claim 4. Is your reason for that the same as the reason that you have just given for your finding that the third element is not present? [977] A. Yes, it is.

Q. You have indicated on Exhibit 32 that you do not find in the Niestle patent the progressive loading called for by the eighth element of claim 4. What is the basis for your opinion on that point?

A. Since the Niestle patent teaches that any holes in the material used shall be filled with oil, there can be no flow through the holes, and, therefore, the feature of progressive loading described by element VIII is not present in the Niestle filter.

Q. Referring now to Exhibit YY or LL, for example, do those exhibits illustrate, in your opinion, a practical filter? A. No. They don't.

Q. Why not?

A. There are many difficulties in getting such a construction to stay together in the alignment intended by the patent. This is evident in Exhibit YY by the fact that it was found necessary to apply soldering at many points to hold one screen layer in position against another screen layer.

In Exhibit LL, the dirt deposit, as I observed, hides any such soldered places, and so I do not know whether they exist in Exhibit LL. There is apparent, on the upstream face, some misalignment, but on the downstream face of Exhibit LL there are again a few evidences of soldered places where

(Testimony of Sydney F. Duncan.)

it was necessary to do some soldering to keep this thing together, [978] in the shape taught by the patent.

Q. Then, in your opinion, would it be practical to manufacture a filter like Exhibit LL or YY?

A. No. It would not.

Q. Do any of the prior-art patents that you have referred to on Exhibit 32, in your opinion, disclose a filter having the mode of operation of the Farr patented filter?

A. Well, there are some of the filters which show the progressive loading, but taking the total mode of operation as previously described, I do not find one which coincides with the mode of operation of the Farr filter.

Q. Do any of the prior patents disclose a filter which, in your opinion, would have the characteristic performance which you have explained as had by the Farr patented filter?

A. No. I don't think so. [979]

* * * * *

Q. Do you find in any of the prior patents referred to in Exhibit 32 the combination of elements set forth in claim 4 of the Farr patent in suit?

A. No, I don't.

Q. On the succeeding pages of Exhibit 32, have you set forth the elements of claims 5, 7, and 8 of the Farr patent in suit which you find present or absent in the accused P-5 device and in the various prior references in evidence in this case?

A. Yes, I have.

(Testimony of Sydney F. Duncan.)

Mr. Leonard S. Lyon: At this time, your Honor, I will offer in evidence Exhibit No. 31, which the witness produced on direct examination, and I will offer in evidence Exhibit No. 32. No. 31 is a curve sheet.

The Court: All right. Admitted. Both of them are admitted.

(The documents referred to, marked Plaintiff's Exhibits Nos. 31 and 32, respectively, were received in evidence.)

[Printer's Note: Plaintiff's Exhibits 31 and 32 are reproduced in Book of Exhibits.]

Mr. Leonard S. Lyon: You may cross examine.

The Court: No. 30 was admitted yesterday.

Mr. Leonard S. Lyon: Yes, your Honor. [980]

## Cross Examination

By Mr. Harris:

Q. Mr. Duncan, I believe you stated that you had testified as an expert for the Farr Company in a prior action entitled Air-Maze Corporation, et al., vs. Temperatair, Inc., and the Farr Company, No. 2529, Civil, in this court, is that correct?

A. I don't remember the number, but I did.

Q. That was a case before Judge Yankwich.

A. Yes.

Q. Do you have the book of prior art before you? A. Patents?

Q. Yes. A. Yes.

(Testimony of Sydney F. Duncan.)

Q. I want to read you some of your statements that you made in the court in the prior case.

First at page 127 of the record in that case the following question was asked you and the following answer was given by you:

"Q. Will you now refer to the patent to Saint Cyr, 1,118,237, and compare the disclosure of that patent with the Greene patent in suit?

"A. In the patent to Saint Cyr, No. 1,118,237, we have a device for, as he says, 'a device for mixing vaporizing liquid fuels and the object [981] thereof is to provide simple and efficient means for rapidly and perfectly vaporizing and mixing the fuel.' The vaporizing element is made up of these alternate flat and corrugated screens wound spirally to form a solid pack"——

Do you still agree that in the St. Cyr patent it is made up of alternate flat and corrugated screens which are wound spirally to form a solid pack?

Mr. Leonard S. Lyon: Do you mind if the witness has his testimony before him?

Mr. Harris: Not at all.

Mr. Leonard S. Lyon: It is a little difficult to follow just by hearing it.

Mr. Harris: I only have the one copy.

(The transcript referred to was passed to the witness.)

The Court: Page 123?

Mr. Harris: 127, if the Court please.

The Witness: Yes, the material described in St. Cyr is known as screen.

(Testimony of Sydney F. Duncan.)

By Mr. Harris:

Q. Then going on your answer to that same question:

"The special corrugations must be made in such a manner that they cannot nest one into the other. And so, in Figure 3 and Figure 4 are shown the [982] type of corrugation that he suggests. The purpose of the corrugation is to space the layers of wire gauze and allow the air to flow down through the device—rather, the air gasoline vapor droplet mixture to flow down through the device in a direction roughly parallel to the layers of screen."

Do you still agree that in the St. Cyr device the flow of the gasoline vapor droplet mixture is in the direction roughly parallel to the layers of the screen?

A. Roughly parallel to the layers of the wire screen or gauze.

Q. Then on page 128 of that transcript, continuing your answer to the present question, you said:

"The action of the device is described as being to collect the droplets of moisture, the droplets of gasoline on the screen, and as the unsaturated or the lean mixture flows by, to allow them to evaporate into the gas stream. It would act as a filter in that if it collects droplets of moisture it would also collect particles of dirt."

Do you agree that the device shown in the St. Cyr patent would act as a filter?

A. In the sense used in this quotation, yes.

(Testimony of Sydney F. Duncan.)

Q. First of all, the same Farr filter panel was [983] involved in that suit as is involved here and as is shown in the '479 patent in suit here, was it not? A. Yes.

Q. Now, then, on page 129 of that transcript you were asked this question:

"Q. How does the disclosure of the Saint Cyr patent compare with the filters manufactured by defendant, such as the Farr filter, which is Plaintiff's Exhibit 2 here?

"A. There is a considerable degree of similarity between the two, that is, in the Saint Cyr the air flows roughly parallel to the plane of the screen, and in the Farr filter the air also flows roughly parallel to the plane of the screen."

Is it still your opinion that the St. Cyr patent is similar to a considerable degree to the Farr filter here in suit?

A. Yes, in these respects that you have read to me.

Q. Then at the bottom of that page 129 and following on to page 130 of the transcript in that case you were asked the following question:

"Q. What is the function, in the Saint Cyr patent, or benefit that is obtained by angling the crimp with respect to the direction of the air flow, in the form shown at Figure 5, where that [984] angle is employed?

"A. Figure 5 is, of course, a developed view of the screen before it is wrapped up. The assembly is shown at Figure 9 or Figure 2.

(Testimony of Sydney F. Duncan.)

"The Court: It does show, however, the corrugations to be on the same screen?

"A. The corrugations are in the same screen, yes. There is one piece of screen corrugated. But the question related to the reason for the angle as shown in Figure 5, and the purpose of the angle is to assure a change in direction of the air flow as the air and vapor mixture flows down through the device. It will give better impingement of the particles or droplets on the screen to prevent the particles from going right straight through without having an opportunity to impinge on a screen, giving a chance to revaporize."

Now is it still your opinion that the purpose of the angle of the corrugations in the St. Cyr device is to assure a change in direction of the air flow as the air and vapor mixture flows down through the device?

A. The change in direction occurs at the entrance to the spirally rapid screen part of the device. The screen pack is shown installed in a round pipe in Fig. 1—— [985]

The Court: Completely enclosed?

The Witness: Completely enclosed—and a round pipe comes up to the end of that screen pack affair. Theer the air is flowing roughly parallel to the axis of the pipe as it enters the passages of St. Cyr and it changes direction and impingement can take place at the entrance.

By Mr. Harris:

(Testimony of Sydney F. Duncan.)

Q. Those passages themselves change direction from one face to the other, do they not?

A. More or less continuously and gradually because of the fact that they are wrapped up in spiral form.

Q. On page 131 of the transcript that I am referring to you were asked the following question and gave the following answer:

"Q. The Saint Cyr patent uses the term 'wire gauze' as describing woven wire members. What is your understanding of the meaning of the term 'wire gauze'?

"A. As far as I know wire gauze is not accurately defined."

Would your answer be the same if you were asked that question today? A. Yes.

Q. On the same page you were asked this question and gave this answer: [986]

"Q. May wire gauze be employed for the purpose of dust filtering? "A. Yes, sir."

Do you still have that opinion that wire gauze may be used for dust filtering?

A. Yes. The commonest application is in taking dust particles out of gasoline in carburetor flows in which the gasoline flows through the meshes of the wire gauze entirely without any opportunity to do anything else.

Q. Then on page 131 of the transcript in the prior case you were asked the following question and gave the following answer:

"Q. How does the size of the openings in the

(Testimony of Sydney F. Duncan.)

wire gauze compare with the size of the dust particles?

"A. Assuming that wire gauze starts at 100 mesh, that would be an opening somewhat smaller than a hundredth of an inch, which would be about ten thousandths or a little less, because we would have to subtract the wire size. And the dust particles that we mentioned before was four ten thousandths of an inch, so that the size of the opening would be roughly twenty-five times the size of the particles that might be expected to collect. The action of the wire gauze would be [987] substantially the same as in other screen members, the difference being in ease of plugging and resistance to flow, rather than in the type of action that would take place."

Is it still your opinion, Mr. Duncan, that the action of the wire gauze would be substantially the same as in other screen members?

A. If the holes of the wire gauze were not plugged, yes.

Q. Then your opinion would still be that the only difference would be between the ease of plugging and resistance to flow as you have stated it here?

A. Yes. This is a correct statement. But the meshes of the wire gauze have to be open to begin with or else the comparison of particle size versus hole size is meaningless.

Q. Now on page 134 of that transcript you were asked the following question:

(Testimony of Sydney F. Duncan.)

"Will you now refer to the disclosure of the British patent to Row, No. 13,22, and compare the disclosure of that patent with the patent in suit?"

Then came several questions and answers——

The Court: That is, as compared to the Greene patent?

Mr. Harris: As compared to the Greene patent; yes, sir.

The Court: Was the present patent in suit involved in that case also? Had it been issued? [988]

Mr. Harris: It had been issued but it wasn't involved directly except that it was the '479 type of filter which was charged to infringe in that suit, to infringe the Greene patent that was there being sued on. The Greene patent is owned by the Air-Maze Corporation.

The Court: Yes, I understand.

Mr. Harris: And they were suing the Farr Company for——

The Court: And the Farr Company were defending on invalidity of the Greene patent?

Mr. Harris: Invalidity and lack of infringement, I think the pleadings show that are here in evidence. The pleadings in that case are in evidence here.

The Court: Yes, I know they are.

Mr. Leonard S. Lyon: Judge Yankwich held the Greene patent valid but not infringed. I believe that was it.

(Testimony of Sydney F. Duncan.)

The Court: Did he pass on the validity of the '479 patent?

Mr. Harris: No, that was not involved in that case. The '479 patent itself was not involved there because it was not being sued upon at that time.

Mr. Richard S. Lyon: The Farr patent that is here in suit was in that case just as the Schaaf patent is in this case, but Judge Yankwich didn't find it necessary to make any ruling as to whether the Farr patent was valid or not. He simply found the Farr device didn't infringe the Greene [989] patent.

The Court: Very well.

By Mr. Harris:

Q. So on page 134 of the transcript you were asked that question with regard to the Row (British) patent, and then follows several answers and additional questions which I won't read, but going over to page 136 of the transcript the following statement and answer was given:

"The Court: Mr. Clerk, I think you can probably attach it. Go ahead.

"A. In describing the various possible methods by which Mr. Row's object could be obtained, he hit upon a number of different schemes for subdividing the airstream and causing it to impinge upon a wetted surface. He thought of using rods and chains and foranimous plates of various types, such as perforated plates and expanded metal. He suggested the use of woven wire cloth and of a kind of woven flat strip structure, as well as

(Testimony of Sydney F. Duncan.)

smooth plates corrugated and spaced one from the other."

Is it still your opinion that the Row (British) patent teaches a number of ways of causing an airstream to impinge upon a wetted surface?

A. Yes. [990]

Q. Now on page 138 of the record, still testifying as to the Row (British) patent, I will start reading in line 15, your answer in line 15 on that page:

"A. * * * He also discloses the use of spaced flat screen members, with the flow of air either through the screen members or roughly parallel to the screen members, as an air filtering and cooling medium."

It is still your opinion that Row discloses a flow of air either through the screen members or roughly parallel to them as an air filtering and cooling medium? A. Yes.

Q. Then you went on to say:

"The disclosure of the fundamental principles of operation of an impingement type filter are very clearly set forth in Mr. Row's patent."

Do you still agree that that is the situation?

A. I have no quarrel with that statement.

Q. Now, then, referring to your prior art chart, Exhibit 32, under the column entitled "Row (British)" you have a no opposite I in the left margin. In view of your statement just now——

A. Excuse me. Is this Claim 4?

Q. Claim 4, yes.

(Testimony of Sydney F. Duncan.)

What you do mean by the "no" that you have there opposite [991] that element of the claim?

A. I was looking at the wrong column. Just a moment. Claim 4?

Q. Claim 4, element I, Row patent, where it says "no." What do you mean by that?

A. It is disclosed in the Row patent that the water tank at the top of the device shall allow water to flow slowly down the plates, whatever they may be, whether chains of bars or woven wire or what have you, and that this then does not constitute a panel type of filter of the types presented in testimony here because it is continuously cleaned by the water flow, and this teaching is also contained in the Row patent.

I never contended that Row did not allow the impingement to take place, but a filter panel operating on the principle of impingement of particles on collected surface, as we have used these surfaces all through our discussion, these are filters which collect the particle when it impinges and keeps it for a long time compared to the amount of time that Row keep it. He keeps washing it down all the time.

Q. But so far as the removal of the dust from the air is concerned, the Row construction is an impingement type filter, is it not?

A. Particles impinge on the surfaces of the Row structure; yes. [992]

Q. And are collected there until they are washed away by the water? A. Yes.

(Testimony of Sydney F. Duncan.)

Q. So that in the Row patent the water has two functions: first of all, it assists in the collection of the dust, the removal of the dust from the air and, secondly, it washes the dust off the filter area, does it not? A. It does.

Q. Now you know that oil in impingement type filters is a better collecting or dust-catching agent than water, do you not? A. Yes.

Q. You knew that prior to 1939?

A. I suppose I did. I should have. Certainly.

By Mr. Harris:

Q. Now, suppose you had this Row patent and you did not care about humidifying the air. That is one of the functions of the Row patent, is it not?

A. Yes.

Q. Suppose you did not care about humidifying, all you cared about was dust collection, wouldn't it be an obvious thing for you to do to substitute oil for the water that is shown in the Row patent? [994]

* * * * *

Mr. Harris: I will add this to the question:

Q. Wouldn't it be obvious to you to coat the surfaces of the Row patented device with oil instead of having water always down over them as shown?

A. I am not entirely sure whether it would have been obvious to me in, say, 1939. At the present time it seems obvious enough to me that using oil in place of water on a filtering device where flow does not take place——

(Testimony of Sydney F. Duncan.)

The Court: That is flow of what, flow of oil or water?

The Witness: Continuous flow of the adhesive, whatever it may me, that oil would give superior properties. In a device where, as it does in the Row patent, continuous flow takes place, water is so much more convenient that perhaps by increasing the depth of the filter or something, I would accomplish the same thing. A continuous flow of oil in the Row patent would require pumping it back up to the top, whereas the slight water overflow at the bottom can be wasted into the sewer.

So, if I may split my answer in this way, since you split your question, according to the building of the Row patent and substituting oil, while it might occur, to me would not appear to be favorable. Just spraying the panels of Row with oil and [996] throwing out the humidifying effect that he talks about, that appears to me to be a reasonable substitution, something that I could have easily thought of.

By Mr. Harris:

Q. The reason you qualified it as to 1939 is that at that time you were not as familiar with these panel filters as you are now, is that correct?

A. Well, no.

Q. It is not correct, or it is correct?

A. Oh, excuse me. No. I was not as familiar in 1939 as I am now.

Q. If you had your present knowledge in 1939, your answer would be the same, is that correct?

(Testimony of Sydney F. Duncan.)

A. I think so.

Q. Now, the same thing is true, is it not, of the Farr '480 patent construction, that if you wanted to use that as an air purifier, dust-removal device instead of the combination of dust removal and humidifier, then, the substitution of the dipping of that panel in oil would be an obvious expedient —the substitution of oil for water?

A. In the filter as it stands in the '480 device?

Q. Yes.

A. As it stands, or do we have the same split as we had with the Row question?

Q. Well, using the filter media as shown in the '480 [997] patent, if you wanted to use that simply as an air filter, it would be an obvious expedient to dip that panel in oil?

The Court: You mean to wash out the water apparatus?

Mr. Harris: Yes.

The Court: And just dip the gauze in oil?

Mr. Harris: Yes.

The Witness: Without the washing?

Mr. Harris: Yes.

The Witness: That would be a logical thing to do. Take the screen media of the '480 patent, and if you want to use it for a filter, it will eliminate a lot of difficulties if you just dunk it in oil and let it drain and then put it in place to act as a filter. The passages are pretty big and you can see straight through them, but it would catch dust.

(Testimony of Sydney F. Duncan.)

By Mr. Harris:

Q. Now referring again to the Row patent, you have indicated "no" opposite the Roman numeral VIII as to Claim 4 on Plaintiff's Exhibit 32; yet, opposite VIII under the Merryweather patent you have indicated "yes." How do you reconcile that difference? They are both angle screens, are they not?

A. Yes, they are both angle screens, but in the Merryweather patent this washing feature that I have spoken of is not present.

The screens, if they are oiled, in Merryweather, are [998] dipped once and allowed to plug up before something else happens to them.

In the Row patent, since all of the members are described as being washed, then the dust collection is not the progressive type of thing that I have described as occurring in other devices.

Q. Now, using your direct testimony, it indicates that progressive loading of filter panels of the impingement type was old in the prior art before the patent in suit, does it not?

A. I don't remember saying that.

Q. Well, that is a fact, is it not?

A. Progressive loading was old?

Q. Yes. Well, for example, I refer you to your Exhibit No. 32, Claim 4, under opposite Roman numeral VIII, which you said was the progressive loading portion of the claim; you have indicated that Henshall has progressive loading, that Orem has progressive loading, and that Merryweather has progressive loading, so that progressive loading was old in the panel type filters?

(Testimony of Sydney F. Duncan.)

A. Oh, yes. I was trying to remember a direct answer to that particular question. Oh, yes, in these answers here I have indicated that progressive loading existed.

Q. And all of those patents that I have mentioned show the use of wire screen or screen members for the [999] progressive loading, do they not?

The Court: Which ones? Which patents?

The Witness: Which ones?

By Mr. Harris:

Q. Henshall?

A. No. No screen in Henshall.

Q. Excuse me. Well, which ones do, Orem and Merryweather?

A. Merryweather has wire gauze in it. He is a little confusing about his definitions of screens and wire gauze.

St. Cyr has screen mesh material in it.

Orem——

The Court: Orem what?

The Witness: Orem has screen in it, yes. That is that concentric annular space affair on the intake of a carburetor.

By Mr. Harris:

Q. Now, you have indicated that St. Cyr does not have progressive loading, by the "no" opposite Roman numeral VIII on Plaintiff's Exhibit No. 32, Claim 4. Is that your opinion?

A. That is my opinion.

(Testimony of Sydney F. Duncan.)

Q. If you put the St. Cyr device in a tube and blew air through it, with dust in it, wouldn't the dust progressively load from the inlet to the outlet?

A. The mesh of the member described in St. Cyr would, in my opinion, have to be fine enough so that, if it were [1000] dipped in oil, it would present a solid surface such as it described in the Niestle patent, and the progressive loading, by virtue of having open meshes, would not take place in the St. Cyr device.

Q. Well, suppose you put a light oil on it, that would not clog the openings, then would it progressively load?

Mr. Leonard S. Lyon: I think that assumes a contradictory situation, your Honor, how you do that. There is no such oil that would not fill what St. Cyr is calling for.

The Court: I understand your question to be, suppose you put an oil on it that was light enough so it wouldn't fill the interstices.

Mr. Harris: Yes, that is correct.

The Court: Would it progressively load? Is that what you asked?

Mr. Harris: That is the question, yes.

The Court: The objection is overruled.

The Witness: If the oil that you propose to use on St. Cyr were sufficiently light so that there were open screen members, or if you rebuilt St. Cyr with 10-mesh screen or something with big holes in it, then the progressive loading could take place at the initial part of the loading of the filter;

(Testimony of Sydney F. Duncan.)

but this is not the teaching of the St. Cyr patent, in my opinion.

By Mr. Harris: [1001]

Q. Now, as to the Kaiser and Manning patents——

The Court: Wait a minute now.

Mr. Harris: Excuse me.

The Court: You said in the St. Cyr. Did you mean St. Cyr or Niestle?

The Witness: I said St. Cyr and referred to Niestle in my answer. The wire gauze in St. Cyr——

The Court: It does not require it to be——

The Witness: ——is not dipped in oil, in application.

The Court: It is not required to be coated under the teachings of the patent to St. Cyr?

The Witness: No.

The Court: But it does in Niestle.

The Witness: Yes.

The Court: Well, I am all confused now. I had in mind that you were asking about the Niestle patent.

Mr. Harris: I am asking about St. Cyr, your Honor. Maybe my question was misphrased; I don't know. We are talking about the St. Cyr construction.

The Court: Well, the St. Cyr construction, as I remember, does not require that the wire gauze be dipped in oil so as to form the solid surfaces.

The Witness: No, it does not.

The Court: In Niestle, it does.

(Testimony of Sydney F. Duncan.)

The Witness: In Niestle, it does. [1002]

My answer to the question was that if St. Cyr were dipped in oil so that it would be the impingement type of filter or resembled the impingement type of filter we are discussing, it would present the same surface that Niestle does, which, when dipped in oil, presents a fully clogged wire gauze area.

By Mr. Harris:

Q. But, that is a matter of selection of the viscosity of the oil, is it not, Mr. Duncan? It is just a matter of selection of proper oil as to whether it clogs the interstices or not?

A. Well, there are two factors. One is the mesh of the screen, and the other one is the character of oil—not only its viscosity.

Q. Those two factors are a matter of selection, are they not? A. Yes.

Q. You would know, as a man skilled in the art, that if you wanted to use this as an air filter (indicating device)——

A. What is that?

Q. This is St. Cyr, the model Exhibit V—then, the matter of selection of screen mesh size and the matter of selecting the proper viscosity oil would be relatively simple?

A. Let me get that question straight.

The Court: If you wanted to use this as a filter?

Mr. Harris: Yes. [1003]

* * * * *

(Testimony of Sydney F. Duncan.)

The Witness: If I had already envisioned the combined flow of either along the passages or through the meshes, then I could experiment very easily to determine how to achieve that result with a given screen and a particular oil or some combination of screen mesh and oil.

By Mr. Harris:

Q. Now, oil dipping isn't required in an impingement filter, is it; you don't have to filter with oil?

A. Well, the ceiling of this courtroom is not coated with oil, and it collects dust, if that is what you mean, but it is a very poor commercial device if it is not coated with some kind of adhesive.

Q. But you don't have to coat any of these filter panels with oil to make them work as impingement filters, do you?

A. Impingement takes place but the dust hardly sticks.

Q. Referring back to the St. Cyr patent, what it discloses, is it your opinion that any dust in the air stream [1004] blowing into it, as is shown in the patent, would not progressively load in that filtering device?

The Court: You mean solely the air flowing into it?

Mr. Harris: Just exactly as shown in the patent, with air flowing in, carrying dust, wouldn't that dust in the air be separated out?

The Court: The St. Cyr patent says air and gasoline.

(Testimony of Sydney F. Duncan.)

Mr. Harris: Yes, but the witness testified that this construction of St. Cyr would catch dust as well as the droplets of gasoline.

The Court: Yes.

Mr. Harris: And I want to know what the manner of that dust catching would be, and I am suggesting to the Court it would be the same general type of progressive loading that you referred to here in your testimony, is that correct?

The Witness: I am not sure, for this reason, that I still maintain that it depends upon the mesh of screen. Now, if you have dry screen and air can flow through the meshes and we assume that the gasoline droplets do not interfere with this action by wetting the screen and plugging the holes in the screen, then some type of light progressive loading probably would take place. There is usually a dust filtering ahead of this device, however, to prevent it. [1005]

Q. Now, referring again to Plaintiff's Exhibit 32, the prior art chart, and to the element VII under both the Kaiser and Manning patents, opposite VIII you have "no." Those "noes" indicate that in Kaiser and Manning, in your opinion there is no progressive loading, is that correct?

A. Not necessarily because element VIII contains two features, if I may read it:

"whereby the medium may flow through * * * said members near the entrance of the panel when the filter is clean and partially through said passages and thence through * * * the members located

(Testimony of Sydney F. Duncan.)

progressively toward the exit of the panel as the panel becomes progressively loaded with particles."

The "no" is there on the basis of the entire amount of element VIII and not just solely on the progressive loading. We missed the mesh members through which the medium may flow in Kaiser and Manning.

The Court: We will have the morning recess.

(Short recess.)

The Court: Proceed.

By Mr. Harris:

Q. Mr. Duncan, we were on the Kaiser and Manning patents referred to on Plaintiff's Exhibit 32, opposite VII on that chart you show "no" as to each of those two [1006] patents.

Now do I understand your testimony to be that Kaiser and Manning do have progressive loading or do they not?

A. By that you mean that it loads first at the front and then at the back, so to speak?

Q. Progressively starting with the front and extending to the back.

The Court: The front being where the air is introduced?

Mr. Harris: Yes, your Honor.

The Court: That condition would probably exist, that the first surface to encounter the dust would collect the first.

The Court: Why do you say "no" here then?

The Witness: Because I am answering "no" to the entire element of VIII which says:

(Testimony of Sydney F. Duncan.)

"whereby the medium may flow through * * * said members near the entrance of the panel when the filter is clean and partially through said passages and thence through * * * the members located progressively toward the exit of the panel as the panel becomes progressively loaded with particles."

There is no flow through the members in Kaiser and Manning.

The Court: It has progressively loading but there is no flow through the members? [1007]

The Witness: That is correct, your Honor.

By Mr. Harris:

Q. Now referring to the Moller (British) patent, you are familiar with the fact, are you not, that air filters of that general character are currently made and sold in the United States by the Continental Air Filter Company?

A. Yes, something like this.

Q. And those are infringement type filters, are they not? A. That is right.

The Court: You mean just the Moller patent?

Mr. Harris: The Moller patent we are talking about now.

The Court: You said "those."

Mr. Harris: I was referring in that case to the filters themselves, your Honor.

Q. Showing you Defendants' Exhibit DD, which I think earlier in your testimony you said correctly illustrates the construction of the Niestle (French) patent except for the mesh of the screen members in this model, is that correct?

(Testimony of Sydney F. Duncan.)

A. I don't believe I have had Exhibit DD in my hands except—well, certainly not on the stand.

Q. Would you examine it now and state whether, so far as the filter media is concerned, it is substantially like the filter media illustrated in the Niestle patent?

A. In the structure of the expanded screen members, [1008] Exhibit DD does conform to the French patent to Niestle.

However, this is made of, it looks to me like, 14 or 16 mesh screen and these holes would not be plugged with the ordinary oils we use now as is taught in the Niestle filter.

Q. And as illustrated by Exhibit DD, there are well-defined passageways formed by the wire mesh members, are there not, in this device?

A. Yes, there are.

Q. And those passageways extend from front to back of the filter panel, do they not?

A. From entering air side to leaving air side; yes.

Q. And those passageways subdivide the panel in both dimensions perpendicular to the flow of air through the panel? A. Yes.

The Court: The mesh there, you could coat that with axle grease and that would fill up all the interstices, would it not?

The Witness: Yes, sir.

The Court: Or asphalt?

The Witness: Yes, sir.

By Mr. Harris:

Q. Now in the Niestle patent each one of those

(Testimony of Sydney F. Duncan.)

passageways that goes from the entrance to the exit side of the panel is connected with adjacent passageways on each side by openings, is it not? [1009] A. Yes, it is.

Q. And that is the same general type of construction that is present in the Air-Maze P-5 filtering media, is it not?

A. As concerning the passageways?

Q. Yes.

A. There are passageways in the P-5 filter which connect with other passageways.

Q. Laterally?

A. Laterally, and there are passageways in the Niestle filter that connect with other passageways laterally, yes.

Q. And the angle which those passageways in the Niestle patent make with the entrance face of the panel is substantially the same as the angle that the passageways in the '479 Farr patent in suit make with the entrance side of the panel, is that correct?

A. Well, there is an angle which can be varied at the model maker's wish, but there is an angle.

Q. And the angle in the Niestle patent or passageways is substantially similar to the angle shown in the Farr patent in suit?

A. I think the drawings in the Farr patent in suit show a 30 degree angle, where the Exhibit DD show approximately 45 degrees. In that they are similar.

(Testimony of Sydney F. Duncan.)

Q. There is nothing in the Farr patent in suit which [1010] would indicate what the angle should be that the passageways make at their entrance relative to the face of the panel?

A. No, there is nothing in the writing in the patent.

The Court: It has been testified that Exhibit YY here was built on the teachings of the Niestle patent.

The Witness: Yes, it has.

The Court: Well, these passageways as shown through the glass window on one side of this, do they extend that way all the way through, the same angle, the 45 and down sharp 45 and out?

The Witness: If the six sheets of screen were perfectly aligned those passageways would be the same through the entire filter.

The Court: These passageways here between the screens conform to the Z type of passage in the P-5 filter, do they not?

The Witness: Yes, they do. The Niestle patent teaches, however, that one could continue alternating directions of the passage any number of times. In Fig. 1 of the Niestle patent the passageway is a W, whereas in the Fig. 5 of the Niestle patent the passageway is a Z.

The Court: And this conforms to Fig. 5?

The Witness: This one conform to Fig. 5.

The Court: In Exhibit YY and that little one you have [1011] in your hand there?

(Testimony of Sydney F. Duncan.)

The Witness: Exhibit DD. I don't have it anymore.

(The exhibit referred to was passed to the witness.)

The Witness: Exhibit DD is also a Z.

The Court: Substantially the same angle as Exhibit YY?

The Witness: Substantially the same angle as Exhibit YY.

The Court: These passageways alternate?

The Witness: How do you mean, alternate?

The Court: The one nearest the window on Exhibit DD and on Exhibit YY shows a distinct passageway, but the passageway immediately next to that alternates half way between this passageway and the one shown above it on the window.

The Witness: Yes, your Honor. And that accounts for the interconnection between the two passageways which is perhaps more clearly seen on Exhibit DD in that there is a hole formed by the fact that the expanded metal type of structure is used.

The Court: I see on its face that this Exhibit DD is open on two sides, one on the end and one on the end next to the window.

The Witness: That passageway is offset half way.

The Court: It is offset half way with respect to the one next to it.

The Witness: Yes. [1012]

(Testimony of Sydney F. Duncan.)

The Court: And the next one to the left of that one corresponds to the one on the extreme right.

The Witness: That will be true. Every other passageway will be in line.

The Court: And that would be true likewise of this Exhibit YY?

The Witness: Yes, your Honor, and of Exhibit LL, which is the dirty one.

By Mr. Harris:

Q. Mr. Duncan, relative to this Niestle patent, there has been some mention made of welding in these models. Don't you note some black dots on the drawings of the patent which indicate solder or welding at the connections of the screens?

A. (Examining exhibit) I don't think the patent teaches anything about those black dots.

Q. Isn't that the way you interpret it, as being soldered connections?

The Court: What black dots?

The Witness: The dots he is referring to, your Honor, are on Fig. 5 at the point where the first section of the passage shown as a cross-section line, the middle of that cross-sectioned strip of screen, so to speak, there is a black dot which shows a little better in some photostats than others.

The Court: It looks to me as though some fellow was [1013] using it as a place to draw a line.

The Witness: These are the black dots referred to, and in my estimation that is a draftsman's happenstance because he had to draw lines at two different angles at that particular point and his ink ran a little bit.

(Testimony of Sydney F. Duncan.)

By Mr. Harris:

Q. Referring again to this prior art chart, Exhibit 32, and to the page entitled "Claim 7," under the column "Niestle (French") and III, you say "no." That is, you mean that the Niestle patent does not disclose mesh screening members, is that correct?

A. In the sense that I have testified in each case with respect to this particular element, that when the Niestle patent is built according to the disclosures of the patent, whatever media is used presents a solid coated surface without the opportunity of air flow through the material of the member.

Q. Now IV, under the Niestle patent, you also have "no" and that element, IV, reads, "passages of relatively large size as compared with the openings in said * * * members." That I assume is predicated upon——

The Court: Just a moment. IV? I do not see it.

Mr. Leonard S. Lyon: Claim 7.

Mr. Harris: Claim 7.

The Court: I beg your pardon. [1014]

By Mr. Harris:

Q. That I assume is predicated on your answer to the last question, that in Niestle the members do not have any openings through them when they are coated, is that correct?

A. That is right.

Q. And that is the only difference?

A. That is the only difference.

(Testimony of Sydney F. Duncan.)

Mr. Harris: That is all.

Mr. Leonard S. Lyon: That is all.

The Court: Step down.

(Witness excused.)

Mr. Leonard S. Lyon: The plaintiff rests, your Honor.

Mr. Harris: The defendant rests. [1015]

* * * * *

The Court: Are you ready to proceed with the arguments?

* * * * *

Mr. Harris: First, if the Court please, in the press of the trial we neglected to offer in evidence the deposition of Richard Spencer Farr taken August 29, 1950, which was on file with the clerk, and I, at this time, offer that deposition and attached exhibits in evidence in this case.

The Court: That was taken under Rule 45 (b)?

Mr. Harris: Under 43 (b).

The Court: 43 (b) or whatever it is.

Mr. Harris: Yes. Pursuant to the Rules of Civil procedure. [1020]

* * * * *

Mr. Leonard S. Lyon: I haven't any objection to it, your Honor.

The Court: But, usually, when the witness is present whose deposition has been taken, only those portions of the deposition used for impeachment purposes are admissible. However, if there is no objection, it may be admitted and marked in evi-

dence as the defendants' next exhibit in order, which would be AAA.

The Clerk: AAA.

Mr. Harris: AAA.

(The deposition referred to was marked as Defendants' Exhibit AAA and received in evidence.) [1021]

[Printer's Note: Defendants' Exhibit AAA is reproduced in Book of Exhibits.]

* * * * *

The Court: Just a moment, on that one point. I hope you do not mind if I interrupt by asking Mr. Lyon a question.

Mr. Harris: No, your Honor. I welcome your interruptions.

The Court: On your chart that you have presented to me, which I think is Exhibit No. 32, it seems to me that you have indicated that each one of the eight elements that you claim in the patent in suit has been separately disclosed in some one or other of the prior-art patents.

Mr. Leonard S. Lyon: I think that is true, your Honor.

The Court: Then, you maintain that this is a combination patent and not a mere aggregation of old elements?

Mr. Leonard S. Lyon: That is our position.

* * * * * [1058]

The Court: There is no evidence in the case that the Orem device was ever made and sold

commercially or that it worked successfully.

Mr. Harris: No, there is no evidence of that, your Honor. I concede that.

The Court: And the evidence in the case here would warrant the inference that the air filter made by the plaintiff was a commercial success, therefore it failed a need which had not been filled by devices theretofore on the market.

Mr. Harris: I think they have done very well with it. Yes, I concede that. [1080]

* * * * *

The Court: This application is signed and sworn to April 1, 1940.

Mr. Harris: You are referring now, if your Honor please, to the application for the patent in suit?

The Court: Yes. I am referring to the application which is the original document in the file wrapper of the patent in suit.

Mr. Harris: Then, if the Court please, that is at page 11 of the file wrapper, which I believe you are referring to, your Honor.

The Court: Yes.

Mr. Harris: That is the point. That is not the signature of the application. The application has to be separately [1087] signed.

Mr. Leonard S. Lyon: It is also signed on the first page, your Honor, page 4 of the document.

The Court: Where it says "Petition and Power of Attorney."

Mr. Leonard S. Lyon: It says that "patent may be granted to him for the Air Filter Panel set forth in the annexed specification," with the inventor's name, Morrill N. Farr.

The only place that counsel is talking about is on page 12.

The Court: Yes. Do you claim he signed it?

Mr. Leonard S. Lyon: He signed it twice, but he did not sign it three times.

The Court: He signed it and he verified it?

Mr. Leonard S. Lyon: That is right.

The Court: In other words, does the law say the application for patent has to be signed at the end?

Mr. Leonard S. Lyon: No.

Mr. Harris: This is Section 33, Title 35 of the statute, which says, "The specification and claim shall be signed by the inventor."

It does not say where they shall be signed, but it says they shall be signed by the inventor.

The Court: Well, counsel, it seems that the petition in the beginning here refers to them as annexed, that being signed. [1088] It is signed by the inventor. Otherwise, is he going to have to sign every page, every line and every word?

Mr. Harris: No. He signs at the end, as a general thing, that is all. He signs the second specification. The Patent Office said he had to sign it, your Honor. The Patent Office said here he had not signed, and that he must file a signed application before the patent issues.

The Court: Where does it say that?

Mr. Harris: Well, all right, we will find that. I think it is in the very last action taken by the Patent Office. Yes, at page 87 of the file wrapper:

"Attention is again directed to the fact that the specification is unsigned. A properly signed permanent copy of the specification as originally filed is required."

They had required that on the first action that they took. They said it wasn't properly signed.

At page 13 they said:

"This application is informal in that the specification is unsigned. A new specification properly signed is required."

So the defendant is saying that there was not any specification or claim before the Patent Office before February, 1942, which was more than two years.

The Court: Does the Patent Office have any rule or regulation which says it shall be signed at the end? [1089]

Mr. Harris: I will have to read the rule to your Honor.

The Court: Of the specifications?

Mr. Leonard S. Lyon: The present rule?

Mr. Harris: Yes.

Mr. Leonard S. Lyon: The present rule only requires one signature to the whole thing.

Mr. Harris: That is right. We would have to go back, and get the rule as of that time.

The Court: In 1939?

Mr. Harris: That is right.

Mr. Lyon: The present rule, your Honor, that is an entirely ministerial rule of the Patent Office. The statutory rule has not been changed, and the present ministerial rule of the Patent Office, instead of requiring three signatures on the papers, requires one signature, that is all. And here there were two, and the Patent Office wanted a third one, which has nothing to do with the statute at all.

Mr. Harris: I don't know that there is any evidence in this case that that first asserted signature is the signature of Morrill Farr. There is no affidavit that it is. It does not say it is his signature.

Mr. Leonard S. Lyon: You can compare it.

The Court: It says, "Inventor signs full name:".

Mr. Harris: It just says "Inventor's name."

The Court: And in this matter I think we can indulge in [1090] the presumption that the law has been obeyed, can't we?

Mr. Harris: The Patent Office says not. At any rate, that is our point on that. I don't want to belabor it, but I think it is a defense.

The Court: I don't think it is good. I think the application for patent was signed and dates back to the original application, the original one that was filed and rejected, and if that is not true, in any event it dates back to this one filed by Lyon & Lyon. [1091]

* * * * *

The Court: Now does not the P-5 effect a multiple subdivision of the panel in both directions,

not all the way through but at least partially and alternately?

Mr. Harris: I don't think if your Honor please, that [1106] just these isolated contact points throughout the depth of the P-5 filter——

The Court: But you have an opening and it goes in a little ways, do you not?

Mr. Harris: Yes. Then it can spread out any way it wants to.

The Court: Then there is another opening that goes another leg of the Z, and another one.

Mr. Harris: It goes in all different directions.

The Court: So is that not a multiple subdivision of the panel?

Mr. Harris: No, I don't think it is a subdivision at all; it is just points spotted through the panel.

The Court: But they are multiple subdivisions.

Mr. Harris: Your Honor, I wouldn't say.

The Court: But you have paths where the air flows, do you not, in addition to flowing through the mesh?

Mr. Harris: I have a very large number of different paths that the air may take, and probably does take.

The Court: Are they not subdivisions of the panel in both directions?

Mr. Harris: No, I don't think so.

The Court: In other words, instead of being one continuous, although changing direction, as you assert the Farr to be, yours has a number of passages which are changed. You [1107] point out

that air can go in one and come out in five or six others, whatever it is.

Mr. Harris: Yes, sir.

The Court: Those are exits, are they not, these channels?

Mr. Harris: Yes.

The Court: They are passages.

Mr. Harris: They are paths through which the air may flow in going through the screen.

The Court: Are they not multiply subdivided?

Mr. Harris: No, I can't visualize those as subdividing that panel in any respect.

The Court: How does your panel get subdivided?

Mr. Harris: I don't think it is subdivided. I think it merely has different paths through which the air may flow through a multiplicity of it from any starting point.

The Court: That is what they say they claim here, multiple subdivisions.

Mr. Harris: Well, it doesn't subdivide it in the vertical dimension.

The Court: It subdivides it in the vertical dimension by virtue of the crimps.

Mr. Harris: No, because in the crimps, if your Honor please——

The Court: I think the vertical crimp rather than your [1108] Z. In other words, you have a crimp vertically in a Z shape.

Mr. Harris: I don't know that we have a crimp vertically.

The Court: They are not at right angles, but they are crimped vertically generally according to the——

Mr. Harris: The sheets of material lie in a horizontal plane.

The Court: Yes, and the crimps are up and down.

Mr. Harris: The crimps are up and down.

The Court: Let us call that vertical.

Mr. Harris: Yes.

The Court: And then they run zigzag in a Z shape, do they not?

Mr. Harris: Yes, they do.

The Court: And each one of those forms a passage?

Mr. Harris: No, it does not, your Honor.

The Court: It forms multiple passages?

Mr. Harris: No, your Honor. Those corrugations are oppositely disposed and it is only where the corrugations, the crests of the corrugations, cross that there is any contact point. That is shown by Exhibit——

The Court: Yes, I remember that. But the air can go in one of these channels and come out that same channel, can it not?

Mr. Harris: I don't see how it could.

The Court: Where is your plastic exhibit with the strings?

Mr. Harris: Exhibit SS shows various paths through which the air may travel starting in at one entrance opening on the entrance side of the panel.

Exhibit I, which has the green and red lines on it, illustrates that it is only where those green and red lines cross that there is any contact between adjacent layers. It is only where the green and red lines cross that you have any contact. Those are merely points, contact points.

The Court: Let us take this little pathway here on this Exhibit L——

The Clerk: That is not our exhibit number, your Honor.

The Court: Is this not in evidence?

The Clerk: That was on the pretrial.

Here you are.

(The exhibit referred to was passed to the Court.)

The Court: Exhibit 6.

Any one of these little corrugations here, the air can come in one side and go out that same one without leaving that corrugation, can it not?

Mr. Harris: I suppose it could. There is no evidence that it would or that it would even be likely to. I don't think it would.

The Court: How about your strings? Your strings show [1110] that it would and does, and also your diagrams.

Mr. Harris: The strings show that it can go through any one of a number of paths.

The Court: But it can also go out the same one that it enters.

Mr. Harris: Yes, I think that is true.

The Court: Whether it is the upper one, which does not lie—well, I do not know how you would say it—crosswise or something to the other one.

Mr. Harris: I think that is true, that it could do it that way.

The Court: So that it can go out. Well, then, is not that a multiple subdivision in both dimensions?

Mr. Harris: No, it isn't subdividing it in the vertical plane, your Honor, because every time one of those corrugations goes over another there is a space, there is an opening around it. In other words, they are open through laterally. It doesn't subdivide it.

The Court: Is not this crimp a subdivision?

Mr. Harris: I don't think it is when you assemble the filter. No, I do not think so.

The Court: When you have your crimp there, that forms a pathway. Suppose the air came along here, it can flow right out that same one, can it not?

Mr. Harris: It is just as though we cut a ditch in the [1111] floor of this courtroom, and it was open on top and we put a zigzag in it and tried to blow air through it. It wouldn't stay in the ditch, it would come out the side.

The Court: Some of it might stay in the ditch.

Mr. Harris: Some of it might stay in the ditch, that is true, but most of it would come out the sides.

The Court: Does not most of the air going through any of these filters go through the screens?

Mr. Harris: Yes, it does, it goes through the screens, I agree with that, when the filter is clean.

The Court: When the filter is clean, and when it begins to clog up it goes further until it goes through the screen, but some of it goes out the same hole that it went in. [1112]

Mr. Harris: Well, I don't know.

The Court: Doesn't it?

Mr. Harris: I don't know whether it does or not, frankly. I don't think we have any testimony on that.

The Court: Well, that is what the testimony said. [1113]

* * * * *

## ARGUMENT ON BEHALF OF THE PLAINTIFF

Mr. Leonard S. Lyon: May the Court please, at the outset of this case I stated that the filter of the panel of the patent in suit had a novel construction and that the essential elements of that construction consisted, first, of a plurality of sheets of crimped wire screen arranged parallel to the direction of airflow and forming passages through the filter.

Second, that the sheets divided the panel in two dimensions into a plurality of subdivisions.

And, third, that a portion of each of the passages was disposed angularly so as to provide a change

of direction of [1130] the flow of the air through the passages.

I stated that those were the essential characteristics of this patented filter. Mr. Duncan's testimony was to the same effect.

I next stated that this construction provided a unique operating characteristic, and by "unique" I mean an operating characteristic which had never been known or ever been had by any filter in the art before.

This operating characteristic is set forth at page 1 of the patent in suit, column 1, lines 32 to 38, and I think I might just take a moment to restate that. [1131]

* * * * *

Now the patent has a mode of operation which could only be had of this combination formed with wire screen where the operation permits this mode of operation. The new mode of operation of this combination is described in the patent at page 2, column 1, lines 15 to 36, in which it describes this fact, that in the initial operation the air tends to go through the screens where the dust collects by impingement. As those screens become filled the pores in those screens become filled, there is a progressive action down the filter and it is that mode of operation that Mr. Duncan says is responsible for these new characteristics. [1133]

* * * * *

The first one of these that I would like to talk about is the attempt to rely on a device which they

say corresponds to the paper filters but which is made out of wire screen. Your Honor asked a pertinent question. Counsel hasn't made much of the point in his argument, but I think it should be answered. Your Honor asked the question, do I contend that it amounted to invention to make the Detroit paper filter out of wire screen, and I said in reply to that that I certainly did, that if the exhibit which the defendant had produced here which showed that change existed in the prior art, then we wouldn't have a case. [1134]

* * * * *

The Court: In your paper filter, was that not old in the art to use screens for filters?

Mr. Leonard S. Lyon: Yes.

The Court: Does it require invention to substitute something that is already known to be useful for a particular purpose?

Mr. Leonard S. Lyon: Depending on what the effect of that substitution is. [1136]

* * * * *

Now counsel has referred to the Schriber-Roth case and the fact that there was a Claims 4 and 6 in the original abandoned application. He says that because of those claims which were cancelled that the broad claims of this patent cannot cover the device of those narrow claims, and he cites the Schriber-Roth case to that effect and he talks about estoppel. [1150]

* * * * *

The Court: Claims 6 and 4 are narrower in their

statement than your Claims 4, 7 and 8, are they not?

Mr. Leonard S. Lyon: That is correct. And he is trying to say that there is a file wrapper estoppel on the issue of infringement, and he cites the Schriber-Roth case. The Schriber-Roth case isn't a case on file wrapper estoppel on infringement at all, it is a totally different kind of a case. It has nothing to do with the file wrapper estoppel on infringement. The Schriber-Roth case was a case where a man tried to sustain the validity, not infringement, the validity of a claim he got in his patent which didn't mention a feature [1151] which he found he had to have in his claim to avoid the prior art. And he says, I want the Court to read that element into my claim and save my claim, and the Court says, but you had a claim in your patent that had that element in it and you cancelled it out, for some reason, when it was rejected, and now having cancelled the claim for that element you can't expect the Court to read that cancelled claim into your allowed claim to save the claim. There wasn't any question of the scope of the claim at all. [1152]

* * * * *

The Court: Well, it seems to me that this Snow case would be conclusive on the subject, that while the specifications and the drawings may be used to explain a claim, if a particular method of construction is claimed as the best, as stated by that claim, unless the claim of the patent specifically

incorporates it, it would seem to me that the patent is not to be so limited. [1160]

* * * * *

The Court: That Claim 4 of your original application of the patent in suit and Claim 6 of the abandoned application are both narrower than 4, 5, 7 and 8, in that each of them disclosed the laying of the crimped screens so that the angles would touch and they would not mesh.

Mr. Leonard S. Lyon: That is right. [1162]

* * * * *

The Court: On the point that you were making in connection with the Niestle patent, I am fraid I cannot agree with Mr. Harris that that is merely an alternative of having the gauze filled with oil so as to form a continuous thick film, because on the second page of the patent, the first paragraph, he states that according to one embodiment the elements are superimposed so as to form zigzag conduits in which the gas to be purified circulates. In other words, he keeps talking of the conduits there.

And then in the next paragraph he states that according to another embodiment the elements are arranged on each other in such a way that the lips of the slots of the two adjacent elements are interconnected, thus forming conduits of [1169] considerable length. The gas is thus compelled to follow a path between sharply staggered points and these marked changes in the direction favor the deposition of dust.

So it would seem to me that his use of the gauze there was not to partially force the air through it, or the gas as he calls it, but merely to have a little metal which could be coated easily with oil and perhaps hold it better than a smooth surface, to form these paths or conduits. [1170]

* * * * *

Mr. Leonard S. Lyon: The three prior patents that were mentioned just before the recess, the St. Cyr, the Preble and the Kirkham patents, are the three patents on the defendants' chart which are asserted on that chart to show all of the elements of the claims in suit, the combination of the claims in suit. I want it understood that I don't feel——

The Court: I do not think that Preble does. I would not waste any time on that. [1178]

* * * * *

Now I can go through Preble if your Honor thinks it is necessary.

The Court: No, I don't think so. I would not waste any time on it because I do not think it anticipates the combination here. It teaches that there should be these straight screens, both inlet and outlet side. [1179]

* * * * *

The Court: Counsel, I am satisfied that none of these patents which were for washers of air, that is to say, that washed the air with water, anticipated the patent in suit. [1182]

* * * * *

## MEMORANDUM OPINION

The Court: The first thing to determine is the validity of the patent in suit, that is, '479. I have listened with a great deal of interest to the presentation of the evidence and the argument, which has certainly been most excellently done by both counsel.

I do not agree with the defendant's contention that the claims of the plaintiff's patent were anticipated entirely by any previous patent. As I indicated a while ago as to the Niestle patent, it seems to me that it would require, even though the material might be a mesh, that an essential element of that was that there would be a sufficient oil on it to make it a solid wall so that the air would not circulate through the foramans of the screen.

As to the other patents here that involved washing, it seems to me that it is an entirely different use, a different object, and this is not merely the conversion of something which was disclosed in the prior art to a different use such as existed, in my judgment, in the case I tried just before this one involving the automobile feelers.

In all of the cases involving water the air is washed and they do not operate upon the impingement theory. They might impinge for a moment, but they are immediately washed off. So I do not think any of those anticipate completely the elements of the claims of any of the four claims in suit [1198] here.

Nor do I think the St. Cyr does. It has probably given me more trouble in consideration than any

of the others. There are a number of differences in it. I think the most striking one is the fact that while these indentations or valleys or ridges, or however you might describe them, do call for a change of direction of the fluid passing through there, nevertheless one of the big points made in the patent in suit and in the file wrapper and in the argument in obtaining the patent was the abrupt change of direction in these passages which caused turbulence in the air and forced it to pass out and spread over and through the filtering material.

Moreover, again it is required to be encased and is, in a sense, a washer too because it is for the use of a gaseous fuel mixture. I do not see how it could be adapted and perform the same function as the plaintiff's patent in suit here.

Consequently I hold that none of the prior art anticipated all of the claims of the plaintiff's patent. As the plaintiff has stated here, all of the elements which are disclosed in the plaintiff's claims in the patent in suit are old. Each one of them has existed before or been used in some one or another previous device or, as I say, disclosed in a previous patent.

So the question is whether or not there is a sufficient [1199] novelty in the invention or in the combination which the plaintiff has put together here to constitute invention or to be merely an aggregation of ideas or aggregation of previous disclosures.

I am inclined to think that the evidence preponderated very heavily in favor of the plaintiff's

contention that this is not a mere aggregation of elements and that it is a combination which produced a new and useful result, and when I say "new and useful result" I do not just mean cleaning air but all of the things that must be taken into consideration in the manufacture and sale and use and cost and maintenance and upkeep of air filters. And while I recognize the rule to be that commercial success alone is not sufficient to indicate that a thing is new or useful, that is, to the extent that it is invention, nevertheless it is an element which can be taken into consideration in the light of all of the other evidence, and the commercial success of this venture is one of the things which indicates strongly to me, in addition to the other evidence, that it is invention.

Another thing that strikes me in that connection was the very exhaustive and painstaking study made by Professor Rowley for the Association of American Railroads, and his report—I do not recall the evidence as to when it was completed—but the report of the railroads bears the date of 1938, and as I recall I believe he said he conducted [1200] the experiments within the previous year. As a result of that study no suggestion was made for the substitution of wire gauze, for instance, for paper, such as is disclosed in the paper filter on file here—I have forgotten the name or the number of the patent. I believe that was the Kaiser patent?

Mr. Leonard S. Lyon: Yes, your Honor.

The Court: Moreover, the mere fact of that ex-

haustive study made by Professor Rowley would indicate that the industry interested in the matter of air conditioning or air cleaning or air filters was going to great pains and great lengths and spending a great deal of money and doing it scientifically in order to find what apparently the plaintiff put together here in a combination, a successful and novel and useful invention.

I accordingly conclude that the plaintiff's patent is valid in so far as that is concerned.

The matter of the file wrapper estoppel was urged by the defendant only in so far as infringement is concerned, so I come now to the question of infringement.

I think that the defendant's device does infringe. By that I do not mean to say nor to imply that there is no invention in the defendant's device. It might be that the defendant's device is invention in so far as laying the material so that the angles touch each other, or it may be that the addition of another zag or zigzag on the end of [1201] the Z might be invention. But essentially it seems to me, after studying the devices and seeing them here and hearing all of the expert testimony, that they are essentially and basically the same idea. The idea of using the impingement method, the idea of introducing the air along the plane of the filtering material, the idea of having them broken up into zigzags to form the passages and so as to create the turbulence of the air, and its general method of construction and use, seems to me are embodied in the defendant's device so that basically it does infringe.

On the matter of file wrapper estoppel, it does not seem to me that the Supreme Court has reversed the statement made in the Snow case. But in view of my holding I do not think it is necessary to pass on the question as to whether or not there is or is not any file wrapper estoppel because in view of my holding it might be that the defendant's device, that element in their device where the layers are laid upside down against one another so that their angle fits, that might be invention, but basically it still infringes. If it is necessary for me to decide whether or not there is or is not file wrapper estoppel, I will adopt the doctrine of the Snow case and hold that there is not.

And that seems to me to be very logical because the Patent Office has issued the broader claims and it might well be that a person seeking a patent such as the patentee in [1202] this case would concur in the abandonment of a narrow claim in the effort to get and to secure a broader claim where, for instance, under the terms of Claim 4 or 5 or 7 or 8 it seems to me that the layers can be laid either way. These claims in suit do not involve the placing between the layers of the flat screen material. The claims do claim a multiple subdivision of the panel in both dimensions perpendicular to the general direction of the flow of the medium to be filtered, thereby forming passages extending through said filter, the walls of which passages are composed of such mesh members.

If the screen material is taken out and the mesh members are laid together without having their

angles on one another they would either fall in place so that there would be no passages whereby the screen material would form the walls or it would be extremely difficult to so construct it so that by jarring they would not fall together and mesh. The essential thing is that they shall form passages. So would it not be logical for one who is constructing a device under these claims in suit, in order to be sure that the passages are formed, would place them in the position that I call upside down to one another, that is to say, so that the angles of the ridges here would touch one another rather than to fold into one another.

In any event, I do not think there is file wrapper estoppel. I do not think there is anything else for me to pass [1203] on at this time.

I take it that in so far as the matter of any damages for infringement are concerned, that after you gentlemen get through your route in the Circuit Court of Appeals and elsewhere, and if I am affirmed, you will be back here for that purpose. For that reason I will put the matter of damages off calendar to be reset on notice. And counsel will prepare findings of fact and conclusions of law.

Is there any point that I should have touched upon here that I have not or on which counsel would like to have me express myself?

Mr. Leonard S. Lyon: I think not, your Honor.

Mr. Harris: No, your Honor.

The Court: Very well. Court is adjourned.

* * * * *

[Endorsed]: Filed March 20, 1952. [1204]

[Endorsed]: No. 13,352. United States Court of Appeals for the Ninth Circuit. Jules D. Gratiot and Air-Maze Corporation, Appellants, vs. Farr Company, Appellee. Transcript of Record. Appeal from the United States District Court for the Southern District of California, Central Division.

Filed: April 22, 1952.

/s/ PAUL P. O'BRIEN,
Clerk of the United States Court of Appeals for the Ninth Circuit.

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In the United States Court of Appeals for the Ninth Circuit

No. 13,352

JULES D. GRATIOT and AIR-MAZE CORPORATION,

Appellants,

vs.

FARR COMPANY, a corporation,

Appellee.

## APPELLANTS' STATEMENT OF POINTS ON APPEAL

Pursuant to Rule 19 of this Court, the following is appellants' statement of points on appeal upon which appellants intend to rely:

1.

The District Court erred in finding that appellant Air-Maze Corporation is, or has been, doing business within the Southern District of California, Central Division.

2.

In Finding of Fact 5, the District Court erred in finding that none of such prior art filters have the mode of operation or achieve the advantages of the Farr patent in suit.

3.

The District Court erred in finding that the air filter panels of the Farr patent in suit combined the ability to provide a high efficiency in removing dust from air with a lower pressure drop than previous commercially built filters, and erred in finding that such pressure drop did not increase as rapidly as previously built commercial filters as the filter became loaded with dust, and erred in finding that the air filter panel of the Farr patent in suit provided a further, or any, advantage of low cost of manufacture and low maintenance, as well as ease of cleaning.

4.

The District Court erred in finding that the air filter panels of the Farr patent in suit have gone into commercial use at a rapidly increasing rate, and erred in finding that the patent in suit has had a wide, or any, commercial success, and erred in finding that it was responsible for the development of the business of appellee, Farr Company.

5.

The District Court erred in finding that the air filter panel described and covered by claims 4, 5, 7, and 8, or any of them, of the Farr patent in suit is not disclosed in any of the prior art or prior uses pleaded and introduced in evidence by appellants.

6.

The District Court erred in finding that the Farr patent in suit does not disclose an aggregation, and erred in finding that it does disclose a new combination of elements which cooperate together to provide any advantage in the cleaning of the air or any benefits in cost of manufacture, maintenance, or upkeep.

7.

The District Court erred in finding that the devices shown in the prior art patents to Wood, No. 2,252,242; British patent to Kirkham, No. 24,467; British patent to Row, No. 13,222; and British patent to Moller, No. 211,756, or any of them, are not filter panels operating on the principle of impingement of particles on collecting surfaces, and erred in finding that such devices do not remove dust by the same mode of operation referred to in Finding of Fact 4, and erred in finding that such devices do not achieve the alleged advantages of the Farr patent in suit.

8.

The District Court erred in finding that devices shown in the prior art patents to Slauson, No. 1,729,135; Kaiser, No. 2,019,186; Manning, No.

2,079,297; Wood, No. 2,252,242; Moller, British 211,756; and Niestle, French, No. 739,956, or any of them, do not possess the mode of operation referred to in Finding of Fact 4, and erred in finding that none of such devices achieve the alleged advantages of the Farr patent in suit, and erred in finding, if in fact it did so find, that the French patent, No. 739,956, to Niestle, employs solid sheets of material which, when oiled or in use, present a solid wall.

9.

The District Court erred in finding that patent No, 1,118,237 to St. Cyr does not constitute an air filter panel which operates by the impingement of particles on collecting surfaces, and erred in finding that in the device of the St. Cyr patent the crimps changed direction only slowly and do not provide passages which change abruptly in direction as in the Farr patent in suit, and erred in finding that the device of the St. Cyr patent is not adapted to perform by the same mode of operation referred to in Finding of Fact 4, or otherwise, or achieve the alleged advantages of the device of the Farr patent in suit.

10.

The District Court erred in finding that the device of the French patent No. 739,956 to Niestle is a filter made of expanded sheets set at right angles to the intended flow of air, rather than parallel as in the Farr patent in suit, and erred in finding that, when made of metal gauze and oiled, the expanded sheets would present a solid wall, and erred

in finding taht the French patent to Niestle does not operate by the same mode referred to in Finding of Fact 4 or achieve the advantages of the Farr patent in suit.

11.

The District Court erred in finding that, for many, or any, years prior to the alleged invention of the Farr patent in suit, the art was familiar with air filters as identified in Finding of Fact 14, and erred in finding that the art expended great or any effort or money in any scientific study or testing of any air filter panels, and erred in finding that the air filter panel of the Farr patent in suit was not suggested thereby.

12.

The District Court erred in finding that the Farr patent in suit had marked, or any, commercial success, and erred in finding that the prior art failed to produce an air filter having the mode of operation or achieving the advantages of the Farr patent in suit, and erred in finding that any failure of the prior art is an important, or any, factor to support the conclusion that the combination of claims 4, 5, 7, or 8 of the Farr patent in suit represents an invention and not mere mechanical skill, and erred in finding, if it did so find, that the Farr patent in suit represents an invention and not mere mechanical skill.

13.

The District Court erred in finding that appellant Air-Maze Corporation was, or at any time has been, doing business within the Southern District of California.

**14.**

The District Court erred in finding that the P-5 air filter panels manufactured by appellant Air-Maze Corporation and sold by appellant Gratiot are essentially or basically the same as the air filter panels of the Farr patent in suit.

15.

The District Court erred in finding that the said P-5 air filter panel breaks the air up into passages having abrupt angles creating turbulence in the air to force the air through the mesh of the screen.

16.

The District Court erred in finding that claims 4, 5, 7, and 8 of the Farr patent in suit are not limited to the use of flat screen wire between corrugated or crimped screen wire, and erred in finding that such claims were not intended by the Patent Office or by the patentee, Farr, to be so limited.

17.

The District Court erred in finding that claims 4, 5, 7, and 8 of the Farr patent in suit are not limited to the use of crimped wire screen, all of which had the angles of the crimp extending in the same direction, and erred in finding that such claims were not intended by the Patent Office or the patentee, Farr, to be so limited.

18.

The District Court erred in finding that the filing of application Serial No. 327,833 did not abandon any of the forms of air filter shown in application

Serial No. 285,904, and erred in finding that the file wrappers of said applications do not contain any abandonment or estoppel such as would prevent claims 4, 5, 7, and 8 of the Farr patent in suit from including the said P-5 air filter panels.

19.

The District Court erred in concluding that Letters Patent No. 2,286,479 was duly and legally issued.

20.

The District Court erred in concluding that claims 4, 5, 7, and 8, or any of them, of the patent in suit are good or valid in law or cover a new or meritorious invention.

21.

The District Court erred in concluding that appellants, or either of them, have infringed any of the claims of Letters Patent No. 2,286,479 in suit.

22.

The District Court erred in concluding that appellant Air-Maze Corporation, for venue purposes or otherwise, is a resident of the Southern District of California, Central Division.

23.

The District Court erred in concluding that appellee is entitled to any judgment as prayed for in the complaint.

24.

The District Court erred in failing to find and conclude that Letters Patent No. 2,286,479 in suit,

and each of the claims thereof, is void and invalid in law.

25.

The District Court erred in failing to find and conclude that none of the claims of Letters Patent No. 2,286,479 in suit had been infringed by the appellants, or either of them.

26.

The District Court erred in ordering a perpetual injunction to issue, as provided for in Paragraph (4) of the judgment, or otherwise.

27.

The District Court erred in ordering that appellee recover general damages, costs, or interest from appellants, as provided for in Paragraph (5) of the judgment, or otherwise.

28.

The District Court erred in failing to hold that it had no jurisdiction over the person of the appellant Air-Maze Corporation and that as to it venue was improperly founded, and erred in failing to dismiss the complaint in this action as against Air-Maze Corporation upon such grounds.

29.

The District Court erred in its order filed and dated July 13, 1950, denying the motion of appellant Air-Maze Corporation to dismiss the action and to quash the service of process.

30.

The District Court erred in failing to hold that since appellant Air-Maze Corporation had committed no acts of infringement in this District and did not have a "regular and established place of business" in this District, such Court had no jurisdiction of appellant Air-Maze Corporation, and that as to said appellant, venue was improperly founded, and erred in failing to dismiss the complaint in this action and quash service of process as against appellant Air-Maze Corporation upon such grounds.

31.

The District Court erred in failing to find that air filters of the types disclosed in the patents to Farr, No. 2,286,480 and No. 2,286,479 were in public use and on sale and were known and used in this country more than one year prior to the effective date of the filing of the application for the Farr patent, No. 2,286,479, in suit, and erred in failing to find that such air filters embodied every element of every claim of said patent in suit in which they operated in substantially the same way to produce substantially the same result as in the patent in suit, and erred in failing to find and hold that the patent in suit is invalid and void by reason thereof.

32.

The District Court erred in failing to find that air filters of the type disclosed in the patent to Farr, No. 2,286,480, were in public use and on sale and were known and used in this country by others

The following exhibits, to be reproduced in a Book of Exhibits:

Plaintiffs' Exhibits: 1, 1-A, 1-B, 4, 11, 13, 17, 26, 27, 29, 30, 31, 32.

Defendants' Exhibits B, J, Z, AA, HH, MM, NN, OO, VV, XX, ZZ, AAA.

It is hereby further stipulated, subject to the approval of the Court, that the following exhibits need not be printed, but may be considered by the Court in their original form without the necessity of reproduction:

Plaintiffs' Exhibits 2, 3, 5, 6, 7, 8; 9a to 9j, inclusive; 12; 14a to 14g, inclusive; 15(a) to 15(c), inclusive; 16, 18, 22, 23, 28.

Defendants' Exhibits A, C, D, E, F, G, H, I, K, L, M, N, O, Q, U, V, W, X, Y, BB, CC, DD, EE, FF, GG, II, JJ, KK, LL, PP, QQ, RR, SS, TT, UU, WW, YY.

Dated: At Los Angeles California, this 22nd day of May, 1952.

OVERTON, LYMAN, PRINCE & VERMILLE
HYDE, MEYER, BALDWIN & DORAN
GEORGE S. BALDWIN
HARRIS, KIECH, FOSTER & HARRIS
FORD HARRIS, JR.
DONALD C. RUSSELL
/s/ By FORD HARRIS, JR.
Attorneys for Appellants

LYON & LYON
/s/ By RICHARD F. LYON
Attorneys for Appellee

[Endorsed]: Filed May 23, 1952. Paul P. O'Brien

[Title of U. S. Court of Appeals and Cause.]

## STIPULATION RE PRINTING OF RECORD

It Is Hereby Stipulated by and between the parties to the above-entitled action through their respective attorneys, that as to Defendants' Exhibit NN, heretofore designated in its entirety for printing in the printed record on appeal by the "Stipulated Designation of Portions of Record to be Printed and Considered," dated May 22, 1952, only pages 1, 8, and 9 of said Defendants' Exhibit NN shall be printed, or otherwise reproduced, and included in the Book of Exhibits, and that the balance of said Defendants' Exhibit NN shall not be printed but may be considered by the Court in its original form without the necessity of reproduction.

Dated: At Los Angeles, California, this 1st day of August, 1952.

OVERTON, LYMAN, PRINCE & VERMILLE
HYDE, MEYER, BALDWIN & DORAN
GEORGE S. BALDWIN
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